SOIL SURVEY

Sonoma County California

UNITED STATES DEPARTMENT OF AGRICULTURE
Forest Service and Soil Conservation Service
In cooperation with
UNIVERSITY OF CALIFORNIA
Agricultural Experiment Station

Issued May 1972

Major fieldwork for this soil survey was done in the period 1956-64. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1964. This survey was made cooperatively by the Soil Conservation Service; the U.S. Forest Service; the State of California, Division of Forestry; and the University of California Agricultural Experiment Station. It is part of the technical assistance furnished to the Gold Ridge, Petaluma, Santa Rosa, Sonoma Valley, and Sotoyome Soil Conservation Districts.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for agriculture, industry, and recreation.

Locating Soils

All the soils of Sonoma County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the woodland group and range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the range sites and woodland groups.

Foresters and others can refer to the section "Use of the Soils for Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Use of the Soils for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation, Classification, and Morphology of Soils."

Newcomers in Sonoma County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication and, in the section "General Nature of the County."

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION[1]

SONOMA COUNTY is on the coast of the Pacific Ocean, north of San Francisco Bay (fig. 1). The total area of the county is 1,579 miles, or 1,010,560 acres.

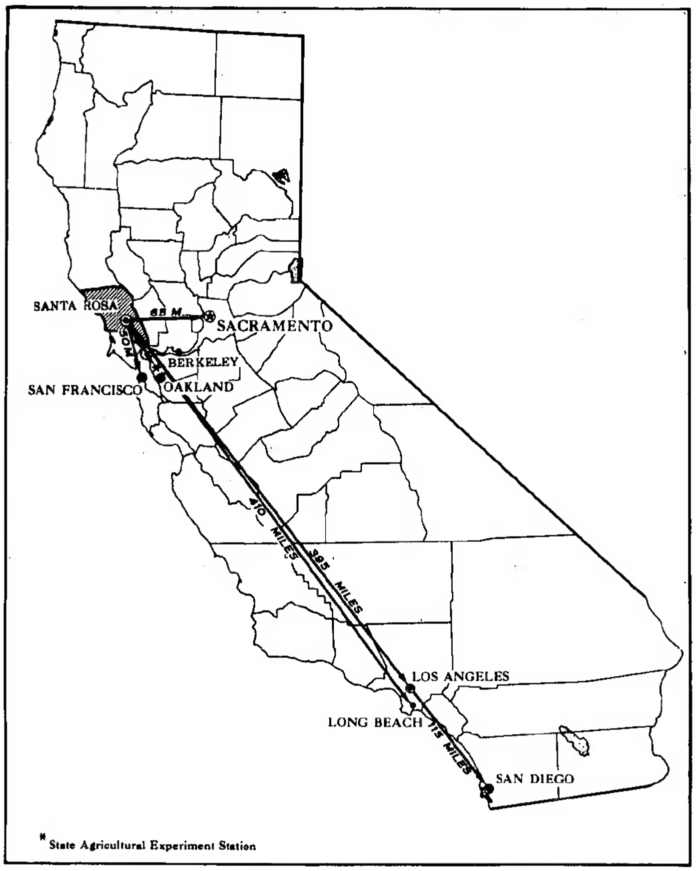

Figure 1.--Location of Sonoma County in California.

Several cities of Sonoma County are on U.S. Highway 101, the "Redwood Highway." This highway divides the county almost in half, entering from the north near the town of Preston and leaving in the south near the city of Petaluma. Santa Rosa, the county seat, is on this highway. It is built on nearly level soils on a plain near the junction of the Mantazas and Santa Rosa Creeks, which flow to the west from hills that surround a large central valley.

In general the northern half of the county is made up of small, fairly rugged mountains that begin at the coast and rise to an elevation of 3,500 to 4,400 feet. The Russian River flows from Mendocino County in a southeasterly direction through the north-central half of Sonoma County and then turns west a few miles south of Healdsburg. Eventually, after passing through the large resort and recreational areas surrounding Guerneville and Monte Rio, this river empties into the Pacific Ocean.

The western part of the southern half of Sonoma County generally is low, rolling grassy hills at an elevation of 500 to 600 feet. The cities of Petaluma and Sonoma are in long narrow valleys in the southwestern and southeastern parts of the county, respectively. East of the Sonoma Plains and on both sides of the Sonoma Valley are grass-covered hills that rise to about 2,000 feet. Tidal flats reclaimed from the San Pablo Bay are at the lower ends of the Sonoma and Petaluma Valleys and the Petaluma plains area.

The several valley floors and adjacent low hills in Sonoma County are farmed intensively. They produce such crops as wine grapes, prunes, pears, apples, row crops, and oats for hay. The hills in the southwestern part of the county are used largely for grazing dairy cattle and sheep. Areas east of the hills are mainly range, pasture, and mixed woodland. Sheep and beef cattle are raised in these areas. Logging of Douglas-fir and redwood is done in most of the northern half of the county. Areas of rangeland and woodland in this part of the county are used for raising large numbers of sheep and beef cattle.

Recreation in the county is provided by the Pacific Ocean and its shores, by the Russian River, and by the many large streams that are used for fishing and swimming.

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[1] Upland parts of Sonoma County were mapped by the State Cooperative Soil-Vegetation Survey. This was a cooperative undertaking of the California Division of Forestry, the Pacific Southwest Forest and Range Experiment Station of the U.S. Forest Service, and the University of California.

Soil scientists made this survey to learn what kinds of soils are in Sonoma County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the kinds of plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and soil phase are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Red Hill and Yorkville, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Blucher loam, 0 to 2 percent slopes, is one of several phases within the Blucher series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map in the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit is shown on the soil map of Sonoma County--a soil complex.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils joined by a hyphen. Empire-Caspar complex, 9 to 50 percent slopes and Josephine-Sites loams, 30 to 75 percent slopes, are examples.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land, clayey, is a land type in Sonoma County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

The general soil map at the back of this survey shows, in color, the soil associations in Sonoma County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Sonoma County are discussed in the following pages. The terms for texture used in the title of the soil associations are for the surface layer.

Soils in the Basins and on Tidal Flats, Flood Plains, Terraces, and Alluvial Fans

The soils in basins and on tidal flats, flood plains, terraces, and alluvial fans are level to steep and excessively drained to poorly drained. These soils consist of very gravelly sandy loams to clays. They formed in alluvium from sedimentary and volcanic material. The areas are mainly in the eastern part of the county.

Elevation of these soils ranges from 2 feet below sea level to 1,200 feet above, and annual precipitation from 20 to 50 inches. The annual temperature ranges from 51° to 68° F., and the frost-free season is 240 to 300 days. The soils are used for hay, grain, orchards, irrigated pasture, range, grapes, row crops, and silage crops.

Five of the soil associations in Sonoma County are in Basins and on tidal flats, flood plains, terraces, and alluvial fans. They make up 20 percent of the county.

1. Clear Lake-Reyes Association

Poorly drained, nearly level to gently sloping clays to clay loams; in basins and on tidal flats

This soil association is in the southeastern part of Sonoma County. It extends from just north of Sebastopol to the flood plains east of Petaluma and to San Pablo Bay and from San Pablo Bay north to the plains south of the town of Sonoma. Slopes range from 0 to 5 percent. The soils of this association formed in alluvium derived from plant remains and mixed with sedimentary and volcanic rock material and sediment from San Pablo Bay. Elevation ranges from 20 to about 300 feet for Clear Lake soils, and from 2 feet below sea level to 10 feet above for Reyes soils. Annual precipitation ranges from 20 to 35 inches. The annual temperature is 58° to 68° F., and the frost-free season is 260 to 300 days.

This association occupies about 6 percent of the county. Clear Lake soils make up about 50 percent of the association, and Reyes soils about 40 percent. The remaining 10 percent is made up of the minor Wright and Yolo soils.

Clear Lake soils have a surface layer of dark-gray clay and clay loam that develops wide cracks as it dries. The substratum is gray and light brownish-gray calcareous clay.

Reyes soils are on tidal flats and in tidal marshes that have been reclaimed through the use of levees and tide gates. These soils consist of grayish-brown, light grayish-brown, and light-gray silty clay that contains strata of organic matter. The water table is at a depth of 0 to 4 feet.

The soils in this association are used mainly to grow oats for hay and grain. Some areas of the Clear Lake soils are used for family orchards, for irrigated pasture, and for field corn grown for silage.

2. Haire-Diablo Association

Moderately well drained and well drained, gently sloping to steep fine sandy loams to clays; on terraces and uplands

This association is mainly in the southeastern and south-central quarter of the county on terraces and rolling uplands. Slopes range from 2 to 30 percent. Haire soils are throughout the county but are mainly in the southeastern part near Diablo soils. Diablo soils are mainly in the south-central quarter of the county. Typically, Diablo soils are on grassy rolling hills. Haire soils are just below them on low undulating terraces and hills that have a cover of grass and oak and lie above alluvial fans and low basins. The soils in this association formed in mixed alluvium and in material derived from coarse-grained soft sandstone and from clay shale. Elevation ranges from 100 to 1,200 feet. Annual precipitation ranges from 22 to 45 inches. The annual temperature is 54° to 58° F., and the frost-free season is 250 to 260 days.

This association occupies about 4 percent of the county. Haire and Diablo soils each occupy about 45 percent of the acreage. The remaining 10 percent is made up of the minor Arbuckle, Clear Lake, Raynor, and Zamora soils.

Haire soils are moderately well drained. They have a surface layer of grayish-brown fine sandy loam, gravelly loam, or clay loam. Their subsoil is pale-brown clay. The substratum is pale-yellow and pale-brown very gravelly and cobbly clay loam.

Diablo soils are well drained. They have a surface layer of dark-gray and very dark gray clay. Their substratum is light olive-gray calcareous clay underlain by calcareous sandstone or shale.

The soils of this association are used for pasture, range, and hay. Sheet erosion is a hazard, especially on the steeper slopes. Deep vertical gullies cut the hillsides and footslopes.

3. Huichica-Wright-Zamora Association

Somewhat poorly drained to well drained, nearly level to strongly sloping loams to silty clay loams; on low bench terraces and alluvial fans

The soils of this association are in basins and on low terraces. They are in the south-central valley on plains near Santa Rosa and near Sonoma. Slopes range from 0 to 15 percent. The soils formed in a mixture of old weathered basic alluvium and sedimentary alluvium. The vegetation is predominantly grass and oak, though forbs grow in places. Elevation ranges from 70 to 500 feet. Annual precipitation ranges from 25 to 45 inches. The annual temperature is 54° to 60° F., and the frost-free season is 240 to 260 days.

This association makes up about 6 percent of the county. Huichica soils make up about 35 percent of the association, Wright soils 30 percent, and Zamora soils 25 percent. The remaining 10 percent is made up of the minor Clear Lake, Yolo, Pajaro, Cole, and Cortina soils.

Huichica soils are in low valleys and on terraces that have a hogwallow, or hummocky, microrelief. These soils are moderately well drained and somewhat poorly drained. Their surface layer is light brownish-gray, pale-brown, and light-gray loam. The subsoil is light brownish-gray clay. The substratum is a light-colored hardpan that is weakly to strongly cemented. It is at a depth of 25 to 40 inches.

Wright soils are somewhat poorly drained. They have a surface layer of brownish-gray loam and sandy clay loam. Their subsoil, which is at a depth of 10 to 30 inches, is dominantly light brownish-gray and light-gray clay. The substratum is light brownish-gray and pale-brown sandy clay loam, clay, and sandy clay.

Zamora soils are well drained. They have a surface layer of grayish-brown and dark grayish-brown silty clay loam and clay loam. Their subsoil is dark grayish-brown and dark-brown clay loam and sandy clay loam.

Wright and Huichica soils are used primarily for pasture and hay, though prunes and grapes are grown on a small acreage. Zamora soils are used mostly for prunes, grapes, and row crops, but in places they are used for pasture or hay.

4. Pajaro Association

Somewhat poorly drained, nearly level to gently sloping fine sandy loams to clay loams; on low terraces and flood plains

This soil association is in long, fairly narrow valleys. Most areas are in the southern part of the county between Petaluma and Two Rock but one area extends from west of Sebastopol to the vicinity of Graton. Slopes range from 0 to 2 percent. The soils of this association formed in alluvium washed from hills of sedimentary soft coastal sandstone and mixed with material from fine-grained hard sandstone and shale. The vegetation is grasses, forbs, shrubs, and wild berry vines. Elevation ranges from 50 to 500 feet, and annual precipitation from 30 to 35 inches. The annual temperature is about 51° F., and the frost-free season is about 270 days.

This association occupies about 1 percent of the county. The Pajaro soils make up about 90 percent of the association, and the remaining 10 percent is made up of the minor Blucher, Goldridge, Steinbeck, and Los Osos soils.

Pajaro soils have a surface layer of grayish-brown fine sandy loam, gravelly loam, or clay loam. The substratum is mottled gray fine sandy loam.

Most of these soils have been cultivated and are used for dryfarmed or irrigated pasture and hay. Row crops and grapes are grown in places on the better drained areas, and corn is grown in a few places mainly for silage. Many fine dairies are on these soils. During the rainy season in winter, some areas of these soils are flooded because of the combined effect of heavy rainfall and excess runoff from tributaries to the main drainageways.

5. Yolo-Cortina-Pleasanton Association

Well-drained to excessively drained, nearly level to moderately sloping very gravelly sandy loams to clay loams; on flood plains, alluvial fans, and low terraces

This soil association is on flood plains, alluvial fans, and low terraces along major and minor streams and drainageways. The largest areas are in valleys of the Russian River and of Dry Creek in the north-central part of the county. The soils of this association formed in alluvium derived from mixed sedimentary rock and basic rock. The natural vegetation consists of annual and perennial grasses and legumes, of scattered oaks and shrubs, and, along streams and channels, of dense thickets of willow trees and wild berry vines. Slopes range from 0 to 9 percent. Elevation ranges from about 70 to 800 feet, and annual precipitation from 25 to 50 inches. The annual temperature is 58° to 60° F., and the frost-free season is 240 to 270 days.

This association occupies about 3 percent of the county. Yolo soils make up about 60 percent of the association, Cortina soils about 15 percent, and Pleasanton soils about 15 percent. The remaining 10 percent is made up of the minor Arbuckle, Manzanita, Pajaro, Positas, and Zamora soils.

Yolo soils are well drained. They have a surface layer of grayish-brown sandy loam, gravelly loam, silt loam, loam, or clay loam. Their substratum is grayish-brown stratified loam.

Cortina soils are excessively drained. They have a surface layer of very gravelly sandy loam or very gravelly loam. Their substratum is grayish-brown very gravelly coarse sandy loam.

Pleasanton soils are well drained. They have a surface layer of grayish-brown and brown gravelly loam, loam, gravelly clay loam, or clay loam. The subsoil is grayish-brown and brown gravelly loam and gravelly clay loam, and the substratum is yellowish-brown and reddish-brown sandy clay loam.

Yolo soils are among the most important soils in the county for farming. They are used for grapes, orchards, row crops, and pasture, and for all other crops adapted to the area. Cortina soils are droughty, but where irrigation water is available, they are used for grapes and other crops and for pasture. Pleasanton soils are highly fertile and are excellent for farming. They are used for grapes, orchards, hay, and pasture.

Soils of the High Terraces, Foothills, Uplands, and Mountains

The soils on high terraces, foothills, uplands, and mountains are nearly level to very steep and moderately well drained to excessively drained. These soils consist of gravelly, very gravelly, or stony sandy loams to clay loams. They formed in material weathered from such rock as volcanic tuff, rhyolite, serpentine, sandstone, shale, and metamorphosed schist, as well as basic igneous rock. The areas are scattered throughout the county.

Elevation of these soils ranges from 100 to 4,000 feet, and annual precipitation is 20 to 70 inches. The annual temperature is 48° to 62° F., and the frost-free season is 230 to 310 days. The soils are used mainly as range and woodland. Smaller areas are used chiefly for pasture, hay, and orchards, though row crops are grown in places.

Ten of the soil associations of Sonoma County are on high terraces, foothills, uplands, and mountains. They make up 80 percent of the county.

6. Spreckels-Felta Association

Well-drained, gently sloping to very steep very gravelly loams to clay loams; on mountain foothills and on high terraces

This soil association is made up of hilly areas that extend southeast of Healdsburg to Santa Rosa. Slopes range from 2 to 75 percent. The soils of this association formed in mixed river sediment and in material weathered from volcanic tuff and basic rock. The vegetation consists mainly of black oak and white oak, madrone, and scattered shrubs, including manzanita and poison oak. The understory is grass and forbs. Elevation ranges from about 300 to 2,000 feet, and annual precipitation from 25 to 35 inches. The annual temperature is 59° to 62° F., and the frost-free season is 260 to 300 days.

This association occupies about 4 percent of the county. Spreckels soils make up about 50 percent of the association and Felta soils about 40 percent. The remaining 10 percent is made up of the minor Laniger, Toomes, and Guenoc soils.

Spreckels soils are on mountain foothills and terraces. They have a surface layer of grayish-brown and light brownish-gray loam and clay loam and a subsoil of brown clay. Below is brown and yellowish-brown, weakly cemented tuff.

Felta soils are on terraces. They have a surface layer of grayish-brown very gravelly loam and a subsoil of grayish-brown very gravelly clay loam. The substratum is grayish-brown very gravelly sandy clay loam.

Soils in this association are used chiefly for range and pasture. The oak trees on the areas produce firewood that is sold locally.

7. Yorkville-Suther Association

Moderately well drained, moderately sloping to very steep loams and clay loams; on uplands

This soil association is on uplands in the northern half of the county. It is on ultrabasic rock intrusions and other igneous rock and on sedimentary rock. Slopes range from 5 to 75 percent. Some of the soils formed in material weathered from metamorphosed basic schist and glaucophane schist, and others formed in material weathered from fine-grained, hard sandstone. The vegetation is grasses, legumes, forbs and scattered oaks, madrone, and shrubs. Elevation ranges from about 300 to 3,000 feet, and annual precipitation from 30 to 70 inches. The temperature is 52° to 56° F., and the frost-free season is 230 to 260 days.

This association occupies about 8 percent of the county. Yorkville and Suther soils make up about 80 percent of the association in equal parts. The remaining 20 percent is made up of minor Hugo, Josephine, and Laughlin soils.

Yorkville soils have a surface layer of dark grayish-brown clay loam and a subsoil of dark grayish-brown clay loam and clay. They formed in material weathered from basic glaucophane schist and metamorphosed schist.

Suther soils have a surface layer of pale-brown loam and a subsoil of pale-brown clay loam and gravelly clay. These soils formed in material weathered from shattered fine-grained sandstone. The sandstone is at a depth of 20 to 40 inches.

Yorkville and Suther soils are used primarily for pasture and range. They are among the better soils in the county for grasses and legumes.

8. Goulding-Toomes-Guenoc Association

Well-drained, gently sloping to very steep clay loams to loams; on uplands

The soils in this association are mainly on ranges of hills that extend nearly the length of the central-eastern third of the county, but Guenoc soils are also in areas that extend from near Wildcat Mountain to 4 to 6 miles north and northeast of Santa Rosa and into the eastern part of that city. Slopes range from 2 to 75 percent. The soils in this association formed in material weathered from such basic igneous rocks as basalt and andesite. The vegetation consists of grasses, forbs, shrubs, brush, and oaks. Elevation ranges from 400 to 2,500 feet, and annual precipitation from 30 to 50 inches. The annual temperature is 54° to 60° F., and the frost-free season is 240 to 280 days.

This association occupies about 8 percent of Sonoma County. Goulding soils make up about 70 percent of the association and Toomes and Guenoc soils about 20 percent in equal parts. The remaining 10 percent is made up of the minor Boomer, Henneke, Josephine, Red Hill, Spreckels, and Supan soils.

Goulding soils have a surface layer of brown and dark-brown clay loam or cobbly clay loam that grades to a subsoil of dark-brown very gravelly clay loam. These soils formed in material weathered from metamorphic basic igneous rock and in material weathered from volcanic flows. The depth to bedrock is 12 to 24 inches.

Toomes soils consist of reddish-brown and dark-brown loam and clay loam. They overlie basalt bedrock, and rock crops out on about 2 to 10 percent of the surface. The depth to bedrock is 5 to 20 inches.

Guenoc soils have a surface layer of weak red gravelly silt loam and heavy loam. Their subsoil, a weak red clay loam and clay, overlies fractured basalt.

Goulding and Guenoc soils are used mainly for range and pasture and produce fair to good forage. Nearly all of the Toomes soils are used for range and watershed. Production of forage is limited on Toomes soils.

9. Kidd-Forward-Cohasset Association

Somewhat excessively drained and well-drained, moderately sloping to very steep gravelly and stony loams; on uplands

The soils of this association are in the eastern part of the county along the boundary line between Sonoma County and Lake and Napa Counties. Some of the soils are on shattered gray rhyolite and other kinds of acid igneous rock, and others are on such weathered volcanic rock as andesite and breccia. Slopes range from 9 to 75 percent. The vegetation is mainly conifers and hardwoods, though brush and shrubs grow in places. The understory is made up of grasses and forbs. Elevation ranges from 800 to 4,000 feet, and annual precipitation from 30 to 70 inches. The annual temperature is 48° to 56° F., and the frost-free season is 240 to 250 days.

This association occupies about 2 percent of the county. Kidd and Forward soils, in equal parts, make up about 60 percent of the association, and Cohasset soils about 20 percent. The remaining 20 percent consists of minor Laniger, Red Hill, Spreckels, and Supan soils and the land type Rock land.

Kidd soils are somewhat excessively drained. They have a surface layer of pale-brown gravelly loam and stony loam. The subsoil is white gravelly sandy clay loam. It is underlain by rhyolite, and in places rhyolite crops out on 10 to 25 percent of the surface. The depth to rock is 5 to 20 inches.

Forward soils are well drained. They have a surface layer of gray and light-gray gravelly loam. Their subsoil is white gravelly sandy clay loam. These soils formed in material derived from rhyolite. The depth to rock is 20 to 40 inches.

Cohasset soils are well drained. They have a surface layer of pale-brown gravelly loam and a subsoil of light-brown gravelly clay loam. These soils are mainly in the northeastern part of the county. They are underlain by weathered andesite and volcanic tuff at depths of 20 to 60 inches.

Kidd and Forward soils are used mainly for range, watershed, and recreation, but a few areas are used for timber. Cohasset soils are used for timber and for limited grazing.

10. Los Gatos-Henneke-Maymen Association

Well-drained to excessively drained, moderately sloping to very steep loams, gravelly loams, and gravelly sandy loams; on mountains

This soil association is in the northeastern half of the county. Slopes range from 5 to 75 percent. The soils in this association formed in material derived from weathered, fine-grained, hard sandstone, shale, and metamorphosed serpentine. The vegetation is mostly manzanita, oaks, chamise, and small shrubs that have an understory of grasses and forbs. Elevation ranges from 600 to 3,500 feet, and annual precipitation from 25 to 70 inches. The annual temperature is 52° to 58° F., and the frost-free season is 250 to 260 days.

This association makes up about 7 percent of the county. Los Gatos soils make up about 50 percent of the association and Henneke and Maymen soils, in equal parts, about 40 percent. The remaining 10 percent is made up of minor Boomer, Huse, Hugo, Josephine, and Montara soils.

Los Gatos soils are well drained. They have a surface layer of grayish-brown and brown loam or gravelly loam. Their subsoil is light reddish-brown and pink heavy loam and gravelly light clay loam. It is underlain by weathered sandstone and shale at depths of 24 to 48 inches.

Henneke soils are excessively drained. They have a surface layer of dusky red gravelly loam and a subsoil of dusky red very gravelly clay. These soils formed in material derived from serpentine. The rock is at a depth of 10 to 20 inches.

Maymen soils are well drained. They have a surface layer of pale-brown and light yellowish-brown gravelly sandy loam. Their subsoil is pale-brown gravelly loam. The substratum consists of material derived from weathered, shattered, hard sandstone. Sandstone is at a depth of 10 to 20 inches.

Soils of this association produce only limited amounts of forage. Most areas are used as watershed and for wildlife habitat and recreation.

11. Hugo-Josephine-Laughlin Association

Well-drained, gently sloping to very steep gravelly loams and loams; on mountains

The soils in this association are on uplands, mainly in the northwestern part of the county. Slopes range from 2 to 75 percent. The soils formed in material derived from weathered, fine-grained, hard sandstone and shale. The vegetative cover on Hugo and Josephine soils is redwood, Douglas-fir, California-laurel, fern, brome, and grass. Laughlin soils have a cover of grass, forbs, oak, and manzanita. Elevation ranges from 600 feet to about 3,000 feet, and annual precipitation from 25 to 70 inches. The annual temperature is 52° to 56° F., and the frost-free season is 240 to 280 days.

This association occupies about 33 percent of the county. Hugo soils make up about 55 percent of the association, Josephine soils about 20 percent, and Laughlin soils about 15 percent. The remaining 10 percent is made up of minor Boomer, Hely, Maymen, Sites, Suther, and Yorkville soils.

Hugo soils have a surface layer of pale-brown very gravelly loam or loam and a subsoil of pale-brown gravelly sandy clay loam and gravelly loam. These soils formed in material derived from weathered sandstone. The sandstone is at a depth of 30 to 60 inches.

Josephine soils have a surface layer of light-brown loam. Their subsoil is light reddish-brown clay loam and fine sandy loam. It is underlain by fine-grained sandstone and shale at a depth of 24 to more than 60 inches.

Laughlin soils have a surface layer of brown loam and a subsoil of brown sandy clay loam. They are underlain by sandstone or shale at a depth of 14 to 36 inches.

Hugo and Josephine soils are the best in the county for commercial timber production. Laughlin soils are used extensively as range and pasture, mainly for sheep and the wool that they produce.

12. Steinbeck-Los Osos Association

Moderately well drained and well drained, gently sloping to steep loams and clay loams; on uplands

Soils in this association are in the southwestern part of the county. Steinbeck soils are on dissected marine terraces, mainly near Petaluma, and Los Osos soils are along the boundary line that separates Sonoma and Marin Counties. Slopes range from 2 to 50 percent. These soils formed in material weathered from sandstone. The vegetation is grasses, forbs, and scattered oaks and brush. Elevation ranges from 400 to 1,200 feet, and annual precipitation from 20 to 35 inches. The annual temperature is 55° to 58° F., and the frost-free season is 260 to 270 days.

These soils make up about 6 percent of Sonoma County. Steinbeck soils make up about 65 percent of the association and Los Osos soils about 25 percent. The remaining 10 percent is made up of minor Cotati, Diablo, and Goldridge soils, and of Kneeland sandy variant.

Steinbeck soils are moderately well drained. They have a surface layer of dark-gray, gray, and light-gray loam. The subsoil is light yellowish-brown clay loam. It is underlain by weakly cemented, soft sandstone at a depth of 20 to more than 60 inches.

Los Osos soils are well drained. They have a surface layer of grayish-brown clay loam and a subsoil of grayish-brown and light olive-brown clay loam and clay. These soils formed mainly in material weathered from fine-grained, hard sandstone but partly in material weathered from shale. Bedrock is at a depth of 15 to 50 inches.

Steinbeck soils are cut by many gullies caused by soil blowing and subsequent water erosion. Overstocking causes accelerated erosion on Los Osos soils, and landslips are a hazard in places in cultivated areas.

Steinbeck soils are used primarily for range, pasture, and hay. Los Osos soils are used chiefly for range and pasture.

13. Goldridge-Cotati-Sebastopol Association

Moderately well drained and well drained, gently sloping to steep fine sandy loams and sandy loams; on coastal terraces and uplands

This soil association is on marine terraces and uplands in the south-central part of the county. Slopes range from 2 to 50 percent. The soils of this association formed in material derived from weathered soft sandstone, siltstone, and shale. The vegetation is redwood, Douglas-fir, oaks, and grass on Goldridge soils and grass, forbs, oaks, and scattered hardwoods and conifers on Cotati and Sebastopol soils. Elevation ranges from 100 to about 2,000 feet, and annual precipitation from 25

to 50 inches. The annual temperature is 52° to 56° F., and the frost-free season is 240 to 260 days.

This association occupies about 6 percent of the county. Goldridge soils make up about 60 percent of the association, Cotati soils, about 20 percent, and Sebastopol soils about 10 percent. The remaining 10 percent is made up of minor Clear Lake, Diablo, and Steinbeck soils.

Goldridge soils are moderately well drained. They have a surface layer of light brownish-gray fine sandy loam and a subsoil of light-gray, pale-yellow, very pale brown, and light yellowish-brown fine sandy loam and sandy clay loam. The substratum is very pale brown and pale-yellow sandy clay loam and fine sandy loam.

Cotati soils are moderately well drained. They have a surface layer of light brownish-gray, grayish-brown, light grayish-brown, and light-gray fine sandy loam and sandy loam. Their subsoil is grayish-brown, light brownish-gray, and light-gray clay. These soils formed in material derived from weakly consolidated siltstone or shale.

Sebastopol soils are well drained. They have a surface layer of pale-brown and very pale brown sandy loam. Their subsoil is pale-brown and light-red sandy clay loam, clay loam, and clay. The substratum is light reddish-brown and reddish-yellow heavy clay loam.

The Goldridge and Sebastopol soils near Sebastopol are used mostly for apple orchards, but small acreages are used for other fruits and for pasture. Only a few wooded areas of Sebastopol soils remain. Douglas-fir and redwood timber of good quality are produced on several thousand acres of Goldridge soils northwest of Cazadero. Cotati soils are used primarily for pasture and range.

14. Kneeland-Rohnerville-Kinman Association

Well drained and moderately well drained, nearly level to steep loams to clay loams; on coastal benches, terraces, and uplands

The soils of this association are on coastal benches, terraces, and uplands in the western part of the county. Slopes range from 0 to 50 percent. The Kneeland and Kinman soils are mainly in the northwestern coastal area north of the Russian River on foot slopes and hills and have slopes of 5 to 50 percent. Rohnerville soils are adjacent to and west of the Kneeland and Kinman soils. They are on coastal terraces next to the Pacific Ocean and have slopes of 0 to 15 percent. The soils of this association formed in material weathered mainly from hard and soft sandstone but partly from shale. Grasses and forbs and scattered brush, hardwoods, and ferns make up the vegetation. Elevation ranges from 100 to about 1,500 feet, and annual precipitation from 30 to 45 inches. The annual temperature ranges from 52° to 56° F., and the frost-free season is 280 to 310 days.

This association makes up about 3 percent of the county. Kneeland soils make up about 30 percent of the association, Rohnerville soils about 25 percent, and Kinman soils about 25 percent. The remaining 20 percent is made up of minor Baywood, Laughlin, Los Osos, Noyo, and Yorkville soils.

Kneeland soils are well drained. They have a surface layer of dark grayish-brown loam and a subsoil of mottled, pale-brown and brownish-yellow clay loam. Fractured and weathered, medium-grained sandstone is at a depth of 25 to 45 inches.

Rohnerville soils are moderately well drained. They have a surface layer of dark grayish-brown loam and silt loam and a subsoil of light brownish-gray and light yellowish-brown sandy clay loam and sandy clay. The substratum is weakly cemented, brownish-yellow sandy clay loam and sandy clay.

Kinman soils are moderately well drained. They have a surface layer of dark grayish-brown loam and clay loam and a subsoil of dark grayish-brown and light olive-brown clay. Weathered sandstone and clay are at a depth of 30 to more than 60 inches.

All of the soils in this association are used for range or pasture. Some row crops have been planted in the past, particularly on Rohnerville soils.

15. Empire-Caspar-Mendocino Association

Well drained and moderately well drained, strongly sloping to steep sandy loams to sandy clay loams; on coastal uplands and terraces

This association is on old terraces and on uplands near the coast in the northwestern part of the county. Slopes range from 9 to 50 percent. The soils formed in material weathered from soft sandstone and shale. The vegetation is mainly stands of Douglas-fir, redwood, Bishop pine, madrone, baywood, and tanoak that have an understory of scattered brush and grass. Elevation ranges from 200 to 1,500 feet, and annual precipitation from 35 to 65 inches. The annual temperature is 52° to 56° F., and the frost-free season is 285 to 310 days.

This association makes up about 3 percent of the county. Empire soils make up about 35 percent of the association, Caspar soils about 30 percent, and Mendocino soils about 20 percent. The remaining 15 percent is made up of minor Goldridge, Hugo, and Josephine soils.

Empire soils are well drained. They have a surface layer of grayish-brown loam. Their subsoil is pale-brown and brown loam and silty clay loam. It is underlain by reddish-yellow silty clay loam. Depth to soft sedimentary rock and marine terrace material is 30 to 60 inches.

Caspar soils are well drained. They have a surface layer of light-gray and white sandy loam and a subsoil of very pale brown and light yellowish-brown clay loam and sandy clay loam. Depth to unconsolidated siliceous sandstone is 45 to more than 60 inches.

Mendocino soils are moderately well drained. They have a surface layer of light yellowish-brown,

yellowish-brown, and yellow sandy clay loam and a subsoil of yellowish-brown sandy clay. Below is pale-yellow strongly weathered sandstone and shale. Depth to the sandstone and shale is 30 to 60 inches.

The soils in this association are used chiefly for timber. Small areas, however, are cleared and used for pasture.

DESCRIPTIONS OF THE SOILS

This section describes the soil series and mapping units in Sonoma County. Each soil series is described in considerable detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of soil series. Alluvial land, sandy, and Coastal beaches, for example, do not belong to a soil series, but nevertheless are listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and woodland group in which the mapping unit has been placed. The page for the description of each capability unit, woodland group, or other group in which the soils have been placed can be found by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (26) 2/.

2/ Italic numbers in parentheses refer to Literature Cited, p. 184.

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF SOILS

Soil	Area	Extent
	Acres	Percent
Alluvial land, sandy	1,907	0.2
Alluvial land, clayey	1,136	.1
Arbuckle gravelly sandy loam, 0 to 5 percent slopes 1/	429	(2/)
Arbuckle gravelly sandy loam, 5 to 15 percent slopes	551	.1
Arbuckle gravelly sandy loam, 15 to 30 percent slopes	153	(2/)
Arbuckle gravelly loam, 0 to 5 percent slopes	2,512	.2
Arbuckle gravelly loam, 5 to 9 percent slopes	542	.1
Atwell clay loam, 30 to 50 percent slopes 1/	3,525	.3
Atwell clay loam, 50 to 75 percent slopes	648	.1
Baywood loamy sand, 2 to 9 percent slopes 1/	610	.1
Baywood loamy sand, 9 to 30 percent slopes	205	(2/)
Blucher fine sandy loam, overwash, 0 to 2 percent slopes 1/	4,221	.4
Blucher loam, 0 to 2 percent slopes	1,406	0.1
Blucher loam, 2 to 5 percent slopes	752	.1
Blucher clay loam, 0 to 2 percent slopes	124	(2/)
Blucher clay loam, 2 to 5 percent slopes	1,117	.1
Boomer loam, 15 to 30 percent slopes	2,036	.2
Boomer loam, 30 to 50 percent slopes	7,317	.7
Boomer loam, 50 to 75 percent slopes 1/	8,583	.8
Caspar sandy loam, 15 to 30 percent slopes	2,947	.3
Caspar sandy loam, 30 to 50 percent slopes	843	.1
Cibo clay, 15 to 50 percent slopes	399	(2/)
Clear Lake clay loam, 0 to 2 percent slopes	4,461	.4

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF SOILS--Continued

Soil	Area	Extent	Soil	Area	Extent
	Acres	Percent		Acres	Percent
Clear Lake clay loam, 2 to 5 percent slopes---------------	1,621	0.2	Dibble clay loam, 15 to 30 percent slopes-------------	330	(2/)
Clear Lake clay, 0 to 2 percent slopes 1/--------------------	17,213	1.7	Dibble clay loam, 15 to 30 percent slopes, eroded------	1,771	0.2
Clear Lake clay, 2 to 5 percent slopes----------------------	2,035	.2	Dibble clay loam, 30 to 50 percent slopes-------------	877	.1
Clear Lake clay, ponded, 0 to 2 percent slopes---------------	4,621	.5	Dibble clay loam, 30 to 50 percent slopes, eroded------	853	.1
Clough gravelly loam, 2 to 9 percent slopes 1/------------	2,843	.3	Dune land---------------------	1,029	.1
Clough gravelly loam, 9 to 15 percent slopes---------------	634	.1	Empire loam, 9 to 30 percent slopes 1/------------------	2,230	.2
Clough gravelly loam, 15 to 30 percent slopes---------------	1,045	.1	Empire loam, 30 to 50 percent slopes---------------------	2,319	.2
Coastal beaches----------------	212	(2/)	Empire-Caspar complex, 9 to 50 percent slopes-------------	1,698	.2
Cohasset gravelly loam, 15 to 30 percent slopes-----------	598	.1	Felta very gravelly loam, 5 to 15 percent slopes 1/--------	1,395	.1
Cohasset gravelly loam, 30 to 50 percent slopes 1/---------	1,924	.2	Felta very gravelly loam, 15 to 30 percent slopes--------	2,707	.3
Cohasset gravelly loam, 50 to 75 percent slopes-----------	649	.1	Felta very gravelly loam, 30 to 50 percent slopes--------	6,735	.7
Cole silt loam, 0 to 2 percent slopes 1/-------------------	508	.1	Felta very gravelly loam, 50 to 75 percent slopes--------	791	.1
Cole silt loam, 2 to 5 percent slopes----------------------	375	(2/)	Forward gravelly loam, 9 to 30 percent slopes 1/----------	1,011	.1
Cole clay loam, 0 to 2 percent slopes----------------------	474	(2/)	Forward gravelly loam, 30 to 75 percent slopes----------	2,587	.3
Cole clay loam, 2 to 5 percent slopes----------------------	109	(2/)	Forward-Kidd complex, 30 to 75 percent slopes-------------	3,285	.3
Comptche gravelly loam, 30 to 75 percent slopes 1/---------	550	.1	Goldridge fine sandy loam, 2 to 9 percent slopes 1/------	6,965	.7
Cortina very gravelly sandy loam, 0 to 2 percent slopes--	3,082	.3	Goldridge fine sandy loam, 9 to 15 percent slopes--------	5,071	.5
Cortina very gravelly loam, 0 to 2 percent slopes 1/-------	1,263	.1	Goldridge fine sandy loam, 9 to 15 percent slopes, eroded---------------------	2,794	.3
Cotati fine sandy loam, 2 to 9 percent slopes 1/-----------	8,612	.9	Goldridge fine sandy loam, 15 to 30 percent slopes--------	13,420	1.3
Cotati fine sandy loam, 9 to 15 percent slopes--------------	2,123	.2	Goldridge fine sandy loam, 15 to 30 percent slopes, eroded---------------------	2,028	.2
Cotati fine sandy loam, 15 to 30 percent slopes----------	971	.1	Goldridge fine sandy loam, 30 to 50 percent slopes--------	5,136	.5
Diablo clay, 2 to 9 percent slopes----------------------	3,487	.3	Goldridge fine sandy loam, 30 to 50 percent slopes, eroded---------------------	500	(2/)
Diablo clay, 9 to 15 percent slopes 1/-------------------	3,634	.4	Goulding clay loam, 5 to 15 percent slopes 1/-----------	2,597	.3
Diablo clay, 15 to 30 percent slopes----------------------	5,060	.5	Goulding clay loam, 15 to 30 percent slopes-------------	5,492	.5
Diablo clay, 15 to 30 percent slopes, eroded--------------	2,490	.2	Goulding clay loam, 30 to 50 percent slopes-------------	13,896	1.4
Diablo clay, 30 to 50 percent slopes----------------------	850	.1	Goulding clay loam, 30 to 50 percent slopes, eroded--------------------	1,567	.2
Diablo clay, 30 to 50 percent slopes, eroded--------------	283	(2/)	Goulding clay loam, 50 to 75 percent slopes-------------	2,657	.3
Dibble clay loam, 2 to 9 percent slopes-----------------	402	(2/)			
Dibble clay loam, 9 to 15 percent slopes-----------------	552	.1			

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF SOILS--Continued

Soil	Area	Extent
	Acres	Percent
Goulding cobbly clay loam, 5 to 15 percent slopes--------	6,042	0.6
Goulding cobbly clay loam, 15 to 30 percent slopes--------	11,551	1.1
Goulding cobbly clay loam, 30 to 50 percent slopes--------	10,949	1.1
Goulding cobbly clay loam, 30 to 50 percent slopes, eroded----------------------	453	(2/)
Goulding cobbly clay loam, 50 to 75 percent slopes--------	836	.1
Goulding-Toomes complex, 9 to 50 percent slopes----------	8,910	.9
Guenoc gravelly silt loam, 5 to 30 percent slopes 1/-----	2,542	.3
Guenoc gravelly silt loam, 30 to 75 percent slopes--------	1,158	.1
Gullied Land------------------	1,271	.1
Haire fine sandy loam, hummocky, 0 to 5 percent slopes---------------------	960	.1
Haire gravelly loam, 0 to 9 percent slopes-------------	1,939	.2
Haire gravelly loam, 9 to 15 percent slopes-------------	713	.1
Haire gravelly loam, 9 to 15 percent slopes, eroded------	545	.1
Haire gravelly loam, 15 to 30 percent slopes-------------	398	(2/)
Haire clay loam, 0 to 9 percent slopes 1/-------------	8,327	.8
Haire clay loam, 9 to 15 percent slopes-----------------	1,298	.1
Haire clay loam, 9 to 15 percent slopes, eroded---------	361	(2/)
Haire clay loam, 15 to 30 percent slopes-----------------	1,556	.2
Haire clay loam, 15 to 30 percent slopes, eroded---------	262	(2/)
Hely silt loam, 30 to 50 percent slopes 1/-------------	3,493	.3
Hely silt loam, 50 to 75 percent slopes-----------------	1,211	.1
Henneke gravelly loam, 5 to 30 percent slopes 1/----------	1,492	.1
Henneke gravelly loam, 30 to 75 percent slopes, eroded---	12,697	1.3
Hugo loam, 30 to 50 percent slopes---------------------	24,191	2.4
Hugo very gravelly loam, 30 to 50 percent slopes----------	7,364	.7
Hugo very gravelly loam, 50 to 75 percent slopes 1/--------	87,984	8.7
Hugo very gravelly loam, 50 to 75 percent slopes, eroded---------------------	2,030	.2
Hugo-Atwell complex, 30 to 50 percent slopes-------------	4,023	0.4
Hugo-Atwell complex, 50 to 75 percent slopes-------------	9,737	1.0
Hugo-Boomer complex, 30 to 50 percent slopes-------------	901	.1
Hugo-Boomer complex, 50 to 75 percent slopes-------------	1,831	.2
Hugo-Josephine complex, 9 to 30 percent slopes----------	3,418	.3
Hugo-Josephine complex, 50 to 75 percent slopes----------	33,672	3.3
Hugo-Josephine complex, 50 to 75 percent slopes, eroded---	1,916	.2
Hugo-Laughlin complex, 30 to 75 percent slopes----------	1,379	.1
Hugo-Los Gatos complex, 50 to 75 percent slopes----------	989	.1
Hugo-Hely complex, 30 to 50 percent slopes-------------	463	(2/)
Hugo-Hely complex, 50 to 75 percent slopes-------------	3,745	.4
Huichica loam, 0 to 2 percent slopes 1/-----------------	3,793	.4
Huichica loam, 2 to 9 percent slopes---------------------	5,831	.6
Huichica loam, 9 to 15 percent slopes---------------------	993	.1
Huichica loam, ponded, 0 to 5 percent slopes-------------	2,967	.3
Huichica loam, shallow, 0 to 9 percent slopes-------------	2,576	.3
Huichica loam, shallow, ponded, 0 to 5 percent slopes---------------------	1,399	.1
Huse stony clay loam, 30 to 75 percent slopes 1/----------	9,126	.9
Josephine loam, 9 to 30 percent slopes----------------	8,743	.9
Josephine loam, 30 to 50 percent slopes----------------	23,269	2.3
Josephine loam, 30 to 50 percent slopes, eroded---------	1,518	.1
Josephine loam, 50 to 75 percent slopes 1/-------------	16,546	1.6
Josephine-Sites loams, 30 to 75 percent slopes----------	1,156	.1
Kidd gravelly loam, 9 to 50 percent slopes 1/----------	1,966	.2
Kidd stony loam, 2 to 30 percent slopes----------------	1,129	.1
Kidd very rocky loam, 30 to 75 percent slopes-------------	794	.1
Kinman loam, 5 to 15 percent slopes---------------------	912	.1
Kinman loam, 15 to 30 percent slopes---------------------	1,108	.1

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF SOILS--Continued

Soil	Area	Extent	Soil	Area	Extent
	Acres	Percent		Acres	Percent
Kinman loam, 30 to 50 percent slopes 1/------------------	2,504	0.2	Los Osos clay loam, thin solum, 5 to 15 percent slopes-------	653	0.1
Kinman-Kneeland loams, 30 to 50 percent slopes-----------	1,538	.2	Los Osos clay loam, thin solum, 15 to 30 percent slopes------	968	.1
Kneeland loam, 5 to 9 percent slopes 1/------------------	157	(2/)	Los Osos clay loam, thin solum, 15 to 30 percent slopes, eroded----------------------	968	.1
Kneeland loam, 9 to 15 percent slopes---------------------	276	(2/)	Los Osos clay loam, thin solum, 30 to 50 percent slopes, eroded----------------------	4,811	.5
Kneeland loam, 15 to 30 percent slopes-----------------	573	.1	Los Robles gravelly clay loam, 0 to 2 percent slopes 1/-----	1,706	.2
Kneeland loam, 30 to 50 percent slopes-----------------	3,560	.4	Los Robles gravelly clay loam, moderately deep, 0 to 5 percent slopes-----------------	2,940	.3
Kneeland rocky complex, 30 to 75 percent slopes-----------	2,069	.2	Manzanita gravelly silt loam, 0 to 9 percent slopes 1/-----	2,473	.2
Kneeland sandy loam, sandy variant, 2 to 15 percent slopes---------------------	758	.1	Maymen gravelly sandy loam, 30 to 50 percent slopes 1/------	11,894	1.2
Kneeland sandy loam, sandy variant, 15 to 30 percent slopes---------------------	517	.1	Maymen-Los Gatos complex, 30 to 75 percent slopes-----------	940	.1
Kneeland rocky sandy loam, sandy variant, 9 to 30 percent slopes-----------------	324	(2/)	Mendocino sandy clay loam, 9 to 30 percent slopes 1/---------	2,707	.3
Laniger loam, 5 to 9 percent slopes---------------------	661	.1	Mendocino sandy clay loam, 30 to 50 percent slopes---------	674	.1
Laniger loam, 9 to 15 percent slopes 1/------------------	1,314	.1	Mendocino-Empire complex, 0 to 50 percent slopes-----------	1,409	.1
Laniger loam, 15 to 30 percent slopes---------------------	2,629	.3	Montara cobbly clay loam, 2 to 30 percent slopes 1/---------	1,408	.1
Laniger loam, 15 to 30 percent slopes, eroded-------------	1,169	.1	Montara cobbly clay loam, 30 to 75 percent slopes-----------	1,718	.2
Laniger loam, 30 to 50 percent slopes---------------------	6,474	.6	Noyo coarse sandy loam, 0 to 15 percent slopes 1/-----------	1,095	.1
Laughlin loam, 2 to 30 percent slopes---------------------	5,002	.5	Pajaro fine sandy loam, 0 to 2 percent slopes 1/-----------	1,393	.1
Laughlin loam, 30 to 50 percent slopes-----------------	20,838	2.1	Pajaro fine sandy loam, 2 to 5 percent slopes---------------	455	(2/)
Laughlin loam, 50 to 75 percent slopes 1/-------------	26,195	2.6	Pajaro gravelly loam, 0 to 5 percent slopes---------------	718	.1
Laughlin loam, 50 to 75 percent slopes, eroded---------	1,703	.2	Pajaro clay loam, overwash, 0 to 2 percent slopes----------	1,577	.2
Laughlin-Yorkville complex, 30 to 75 percent slopes--------	5,290	.5	Pajaro clay loam, overwash, 2 to 5 percent slopes----------	1,152	.1
Los Gatos loam, 30 to 75 percent slopes 1/-------------	23,371	2.3	Pleasanton loam, 0 to 2 percent slopes----------------------	282	(2/)
Los Gatos gravelly loam, 30 to 75 percent slopes----------	8,720	.9	Pleasanton loam, 2 to 9 percent slopes----------------------	595	.1
Los Gatos-Josephine complex, 30 to 75 percent slopes-----	1,974	.2	Pleasanton gravelly loam, 2 to 5 percent slopes 1/----------	1,423	.1
Los Osos clay loam, 2 to 15 percent slopes-------------	4,138	.4	Pleasanton clay loam, 2 to 5 percent slopes---------------	738	.1
Los Osos clay loam, 15 to 30 percent slopes 1/----------	2,514	.2	Pleasanton gravelly clay loam, 2 to 9 percent slopes--------	257	(2/)
Los Osos clay loam, 30 to 50 percent slopes-------------	1,888	.2	Pleasanton-Haire complex, 0 to 9 percent slopes------------	699	.1
Los Osos clay loam, 30 to 50 percent slopes, eroded------	1,750	.2	Pleasanton-Haire complex, 9 to 15 percent slopes-----------	990	.1

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF SOILS--Continued

Soil	Area	Extent	Soil	Area	Extent
	Acres	Percent		Acres	Percent
Positas gravelly loam, 0 to 9 percent slopes 1/-----------	1,097	0.1	Spreckels loam, 15 to 30 percent slopes, eroded---------	1,365	0.1
Positas gravelly loam, 9 to 15 percent slopes-------------	330	(2/)	Spreckels loam, 30 to 50 percent slopes-----------------	5,812	.6
Raynor clay, 2 to 9 percent slopes 1/------------------	906	.1	Steinbeck loam, 2 to 9 percent slopes---------------------	9,059	.9
Raynor clay, 9 to 15 percent slopes---------------------	499	(2/)	Steinbeck loam, 9 to 15 percent slopes------------------	5,108	.5
Raynor clay, 15 to 30 percent slopes---------------------	1,570	.2	Steinbeck loam, 9 to 15 percent slopes, eroded---------	3,528	.3
Raynor clay, seeped, 2 to 15 percent slopes-------------	1,116	.1	Steinbeck loam, 15 to 30 percent slopes-----------------	5,168	.5
Raynor-Montara complex, 0 to 30 percent slopes----------	1,712	.2	Steinbeck loam, 15 to 30 percent slopes, eroded---------	3,857	.4
Red Hill clay loam, 2 to 15 percent slopes-------------	2,404	.2	Steinbeck loam, 30 to 50 percent slopes-----------------	2,177	.2
Red Hill clay loam, 15 to 30 percent slopes-------------	1,603	.2	Steinbeck loam, 30 to 50 percent slopes, eroded---------	3,455	.3
Red Hill clay loam, 30 to 50 percent slopes 1/----------	2,114	.2	Stonyford gravelly loam, 30 to 50 percent slopes-----------	1,900	.2
Red Hill cobbly clay loam, 30 to 75 percent slopes--------	970	.1	Stonyford gravelly loam, 50 to 75 percent slopes 1/---------	11,331	1.1
Reyes silty clay, 0 to 2 percent slopes 1/-------------	22,509	2.2	Stonyford-Boomer complex, 30 to 75 percent slopes-----------	692	.1
Riverwash---------------------	6,225	.6	Supan silt loam, 30 to 75 percent slopes-----------------	938	.1
Rock land---------------------	18,806	1.9			
Rohnerville loam, 0 to 9 percent slopes 1/-------------	3,211	.3	Suther loam, 15 to 30 percent slopes 1/------------------	2,310	.2
Rohnerville loam, 9 to 15 percent slopes----------------	2,656	.3	Suther loam, 15 to 30 percent slopes, eroded-------------	173	(2/)
Sebastopol sandy loam, 2 to 9 percent slopes-------------	2,611	.3	Suther loam, 30 to 50 percent slopes----------------------	14,131	1.4
Sebastopol sandy loam, 9 to 15 percent slopes 1/----------	1,235	.1	Suther-Laughlin loams, 15 to 50 percent slopes--------------	10,307	1.0
Sebastopol sandy loam, 9 to 15 percent slopes, eroded------	906	.1	Suther-Laughlin loams, 50 to 75 percent slopes--------------	7,040	.7
			Terrace escarpments-----------	551	.1
Sebastopol sandy loam, 15 to 30 percent slopes-----------	1,169	.1	Tidal marsh--------------------	3,118	.3
Sheridan coarse sandy loam, 2 to 30 percent slopes 1/-----	219	(2/)	Toomes rocky loam, 2 to 30 percent slopes-1/--------------	1,850	.2
Sites loam, 5 to 30 percent slopes 1/------------------	558	.1	Toomes rocky loam, 30 to 75 percent slopes--------------	2,326	.2
Sites loam, 30 to 50 percent slopes----------------------	3,495	.3	Tuscan cobbly clay loam, 0 to 9 percent slopes 1/-----------	1,555	.2
Sobrante loam, 15 to 30 percent slopes-----------------	1,648	.2	Tuscan cobbly clay loam, 9 to 30 percent slopes-----------	421	(2/)
Sobrante loam, 30 to 50 percent slopes 1/-------------	6,566	.6	Wright loam, 0 to 9 percent slopes----------------------	1,512	.1
Sobrante loam, 50 to 75 percent slopes-----------------	8,777	.9	Wright loam, wet, 0 to 2 percent slopes 1/--------------	4,921	.5
Spreckels loam, 2 to 9 percent slopes---------------------	1,876	.2	Wright loam, shallow, 0 to 5 percent slopes--------------	1,064	.1
Spreckels loam, 9 to 15 percent slopes-----------------	743	.1	Wright loam, shallow, wet, 0 to 2 percent slopes------------	6,118	.6
Spreckels loam, 15 to 30 percent slopes 1/-------------	4,398	.4	Yolo sandy loam, 0 to 2 percent slopes----------------------	1,553	.2

TABLE 1.--APPROXIMATE ACREAGE AND PROPORTIONATE EXTENT OF SOILS--Continued

Soil	Area	Extent	Soil	Area	Extent
	Acres	Percent		Acres	Percent
Yolo sandy loam, overwash, 0 to 5 percent slopes-------------	4,025	0.4	Yorkville-Laughlin complex, 30 to 50 percent slopes--------	13,118	1.3
Yolo loam, 0 to 2 percent slopes 1/--------------------	3,958	.4	Yorkville-Suther complex, 0 to 50 percent slopes-----------	5,815	.6
Yolo loam, overwash, 0 to 5 percent slopes---------------	1,524	.2	Yorkville-Suther complex, 50 to 75 percent slopes--------	756	.1
Yolo gravelly loam, 0 to 5 percent slopes---------------	1,393	.1	Zamora silty clay loam, 0 to 2 percent slopes 1/-----------	9,409	.9
Yolo silt loam, 0 to 2 percent slopes----------------------	4,126	.4	Zamora silty clay loam, 2 to 5 percent slopes--------------	3,002	.3
Yolo clay loam, 0 to 2 percent slopes----------------------	1,468	.1	Intermittent streams and other water------------	514	.1
Yorkville clay loam, 5 to 30 percent slopes 1/------------	3,225	.3	Russian River------------	1,926	.2
			Shale and gravel pits----	135	(2/)
Yorkville clay loam, 30 to 50 percent slopes---------------	13,542	1.3	Total-----------------	1,010,560	100.0

1/ Modal type.

2/ Less than 0.05 percent.

Alluvial Land, Sandy

Alluvial land, sandy (AdA) consists of sandy and gravelly deposits along streams. Stratification is variable, and recent overwashes tend to change the texture of the surface layer from time to time. Streambank cutting and erosion have occurred in some locations.

Vegetative cover is variable but is mainly willow, wild berry vines, woody shrubs, and in many places, grasses and sweetclover. This land type is used for limited grazing and as wildlife habitat. Capability unit VIIw-4.

Alluvial Land, Clayey

Alluvial land, clayey (AeA) consists of nearly level clay loams to silty clays underlain by stratified sand and gravel lenses at a depth of 20 to 40 inches. These areas are mainly on alluvial fans or along river and stream channels in the broad valley areas. They are a heterogeneous mixture of finer soil texture which cannot be mapped as distinct series at the scale of mapping.

This Alluvial land is used for such crops as prunes and pears, as well as for vineyards, row crops, and pasture. Occasionally, Alluvial land is inundated by floodwater. This results in little or no damage, and there may be some beneficial deposition. Capability unit IIs-5.

Arbuckle Series

The Arbuckle series consists of well-drained gravelly sandy loams that have a gravelly clay loam subsoil. These soils formed in alluvium from sedimentary and basic rock. They are on smooth terraces, above stream channels, or on toe slopes of low-lying hills surrounding the main valleys of Sonoma County. Slopes are 0 to 30 percent. Elevation ranges from 50 to 500 feet. Annual rainfall is 30 to 50 inches, the annual temperature is 60° to 62° F., and the frost-free season is 245 to 265 days. The vegetation is chiefly grass, low shrubs, and scattered oak trees. Most areas have been cleared and are used for dryland vineyards, the production of hay, pasture, or orchards. The Arbuckle soils are associated with the Clough, Manzanita, Pleasanton, and Yolo soils.

In a typical profile the surface layer is brown, pale-brown, and light yellowish-brown neutral and slightly acid gravelly sandy loam and loam about 27 inches thick. In some areas the surface layer is gravelly loam. The subsoil is light yellowish-brown and yellowish-brown, slightly acid gravelly clay loam and very gravelly clay loam. The substratum, at a depth of about 72 inches, is very pale-brown, medium acid sandy clay loam.

Arbuckle soils are used mainly for dryland vineyards, hay, and pasture. A few small irrigated areas are used for prune orchards.

The Arbuckle soils in Sonoma County have a darker color and contain more organic matter in the surface layer than is typical for the series elsewhere in California.

Arbuckle gravelly sandy loam, 0 to 5 percent slopes (AgB).--This soil is on old bench terraces along stream and river channels. It is on elevations of 50 to 200 feet above the stream bottoms. Field surfaces may be undulating, and in most places slope is 1 to 3 percent.

Typical profile in a pasture; slope of 3 percent; about 3.5 miles south of Healdsburg (NW1/4 NW1/4, sec. 16, T. 8 N., R. 9 W.):

A11--0 to 6 inches, brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; common fine and very fine pores; neutral (pH 7.0); abrupt, wavy boundary.

A12--6 to 15 inches, pale-brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; massive; soft, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; neutral (pH 7.0); clear, smooth boundary.

A13--15 to 21 inches, pale-brown (10YR 6/3) loam, dark yellowish brown (10YR 4/4) moist; a few, fine, distinct brown and light-brown mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine and fine pores and common medium pores; slightly acid (pH 6.5); clear, smooth boundary.

A3--21 to 27 inches, light yellowish-brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; common fine roots; many very fine and fine pores; common medium pores; slightly acid (pH 6.5); abrupt, wavy boundary.

B21t--27 to 43 inches, light yellowish-brown (10YR 6/4) gravelly clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, firm, sticky and plastic; common very fine roots; common fine and very fine pores; many thick clay films as bridges and in pores; slightly acid (pH 6.2); clear, smooth boundary.

B22t--43 to 52 inches, yellowish-brown (10YR 5/4) very gravelly clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, firm, sticky and plastic; a few very fine roots; common very fine and fine tubular and interstitial pores; many thick clay films as bridges; slightly acid (pH 6.2); clear, smooth boundary.

B23t--52 to 72 inches, yellowish-brown (10YR 5/6) gravelly caly loam, dark brown (7.5YR 4/4) and dark yellowish brown (10YR 4/4) moist; massive; hard, firm, sticky and plastic; common very fine roots; many very fine pores; many moderately thick clay films as bridges; slightly acid (pH 6.5); clear, wavy boundary.

C--72 inches, very pale-brown (10YR 7/4) sandy clay loam, yellowish brown (10YR 5/4) moist;

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massive; hard, friable, slightly sticky, slightly plastic; medium acid (pH 6.0).

The thickness of the solum ranges from 36 to 72 inches. In places varying amounts of gravel are in stratified layers at various depths. The C horizon, consisting of underlying terrace alluvium, is very gravelly in places. Some more gravelly areas of this soil are more droughty than others that have less gravel.

Included in mapping are small areas of Haire gravelly loam and Pleasanton gravelly loam. Also included are areas of a soil which extends 15 to 36 inches to the underlying alluvium.

Permeability is moderately slow in the subsoil of this Arbuckle soil. Runoff is slow, and the hazard of erosion is slight. Fertility is moderate. The available water capacity is 7 to 9 inches.

This soil is used mainly for dryland pasture. Some areas are used for irrigated pasture and for prune orchards and vineyards. Capability unit IIe-1.

Arbuckle gravelly sandy loam, 5 to 15 percent slopes (AgD).--This soil is similar to Arbuckle gravelly sandy loam, 0 to 5 percent slopes, but depth to the underlying terrace material is 10 to 15 inches less than on the gentler slopes.

Included in mapping are small areas of Haire gravelly loam and Pleasanton gravelly loam.

Runoff is medium. The hazard of erosion is moderate.

This soil is used mainly for dryland pasture and the production of hay. A small acreage is used for vineyards and for orchards. Capability unit IIe-1.

Arbuckle gravelly sandy loam, 15 to 30 percent slopes (AgE).--This soil is similar to Arbuckle gravelly sandy loam, 0 to 5 percent slopes, but there is a higher sand and gravel content in the surface layer. This soil is on the edges of broader, more gently sloping terraces or on the adjoining toe slopes. Depth to the underlying material generally is about 30 inches on these slopes.

Included in mapping are small areas of Haire gravelly loam and Clough gravelly loam.

The available water capacity is 5 to 6 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for dryland pasture. Capability unit IVe-1.

Arbuckle gravelly loam, 0 to 5 percent slopes (AkB).--This soil is similar to Arbuckle gravelly sandy loam, 0 to 5 percent slopes, but it has a gravelly loam surface layer.

Included in mapping are small areas of Haire gravelly loam and Pleasanton gravelly loam.

Available water capacity is 8 to 10 inches. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for dryland pasture. Some areas are used for irrigated pasture and for prune orchards and vineyards. Some small local areas are affected by seepage from adjacent higher areas. Problems caused by these local wet spots can be reduced by installing diversion drains. Capability unit IIe-1.

Arbuckle gravelly loam, 5 to 9 percent slopes (AkC).--This soil is similar to Arbuckle gravelly sandy loam, 0 to 5 percent slopes, but it has a gravelly loam surface layer. The steeper slopes tend to dry faster, and the depth is 6 to 10 inches shallower than on the gentler slopes. This soil is near the edges of broad terraces or on slopes where it adjoins other series.

Included in mapping are small areas of Haire gravelly loam and Pleasanton gravelly loam.

The available water capacity is 8 to 10 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for dryland pasture. Some areas are used for irrigated pasture and for prune orchards and vineyards. Capability unit IIIe-1.

Atwell Series

The Atwell series consists of moderately well drained clay loams that have a clay loam and silty clay subsoil. These soils formed in material weathered from metamorphosed fine-grained sandstone and shale. A thick, gray, gleyed clay layer has been formed in the substratum just above the sandstone and shale. These soils are on wooded uplands, generally in the west-central part of the county near the mouth of the Russian River. Slopes are 30 to 75 percent. Elevation ranges from 400 to 2,000 feet. Annual rainfall is 45 to 55 inches, the annual temperature is 55° to 57° F., and the frost-free season is 225 to 245 days. Vegetation is chiefly hardwoods, such as oak, baywood, and madrone, and conifers such as redwood and Douglas-fir. The Atwell soils are associated with the Hugo, Josephine, and Hely soils.

In a typical profile the surface layer is light brownish-gray, very strongly acid clay loam about 4 inches thick. Above this is a layer of duff litter of madrone leaves and twigs. The subsoil is very pale-brown to dark-brown clay loam and silty clay. It is strongly acid to medium acid and is about 35 inches thick. The substratum is gray, neutral clay that, in a few places, is mixed with fragments of fine-grained sandstone.

Atwell soils are used mainly for producing timber. A few small glades and grassy areas are used for grazing by sheep and cattle. These soils tend to slip when disturbed and are difficult to manage for nonfarm purposes.

The Atwell soils in this county contain less organic matter and are paler in color than is typical for the series elsewhere in California.

Atwell clay loam, 30 to 50 percent slopes (AtF).--This steep soil is on uplands. It is commonly in swales and draws on wooded hillsides.

Typical profile on a southeast-facing hillside having complex concave relief; slope of 42 percent; 2.5 miles south of Monte Rio and south of the

Bohemian Highway on old logging road (SW1/4 NW1/4 sec. 20, T. 7 N., R. 10 W.); the profile was dry when examined:

O1--1 1/2 inches to 0, duff litter of madrone leaves and twigs.

A1--0 to 4 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; strong, moderate and coarse, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and coarse roots and a few medium roots; many, fine, interstitial pores; very strongly acid (pH 5.0); abundant white mycelia; about 10 percent gravel; clear, wavy boundary.

B1--4 to 18 inches, pale-brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and coarse roots and many medium roots; many, fine, interstitial pores; strongly acid (pH 5.5); abundant white mycelia; about 10 percent gravel; gradual, smooth boundary.

B21t--18 to 28 inches, very pale brown (10YR 7/3) and pale-brown (10YR 6/3) heavy clay loam, dark brown (10YR 4/3) moist; weak, coarse, granular structure; slightly hard, friable, sticky and slightly plastic; a few fine roots and common medium roots; many, very fine, tubular and interstitial pores; a few moderately thick clay films in pores; strongly acid (pH 5.5); abundant white mycelia; about 10 percent gravel; abrupt, wavy boundary.

IIB22tg--28 to 39 inches, brown (10YR 5/3) and dark-brown (10YR 4/3) silty clay that has common, medium, distinct, dark-brown mottles; when moist, dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) and having common, medium, distinct, dark-brown mottles; massive; very hard, very firm, sticky and very plastic; many medium and coarse roots and a few fine roots; many, very fine, tubular pores; common, moderately thick clay films in pores and as bridges; medium acid (pH 5.7); clear, smooth boundary.

IICg--39 to 64 inches, gray (N 5/0) clay, dark gray (N 4/0) and very dark gray (N 3/0) moist; moderate, medium, angular blocky structure; very hard, extremely firm, sticky and very plastic; many medium and coarse roots and a few fine roots; many, fine, tubular pores; common, moderately thick clay films in pores and as bridges; neutral (pH 7.0); many feet thick.

The A horizon ranges in color from dark grayish brown to very pale brown and light brownish gray. Depth to the C horizon ranges from 30 to 50 inches. Gravel content is extremely variable and ranges from negligible to 15 percent by volume.

Included in mapping are areas of Hugo very gravelly loam and Hely silt loam. Small areas of soils having slopes less than 30 percent are also included.

Permeability of the subsoil is very slow, and runoff is rapid. The hazard of erosion is high and slips are common. Fertility is moderate. The available water capacity is 9 to 11 inches.

This soil is used for woodland and for recreation. Capability unit VIe-3; woodland group 8.

Atwell clay loam, 50 to 75 percent slopes (AtG).--This soil is similar to Atwell clay loam, 30 to 50 percent slopes, but the depth to the substratum is only 22 to 34 inches. In addition, landslopes on this soil are more common.

Included in mapping are small areas of Hugo very gravelly loam, Hely silt loam, and some areas of soils that have slopes of less than 50 percent.

Runoff is very rapid, and the hazard of erosion is very high. The available water capacity is 5 to 7 inches.

This soil is used for woodland and for recreation. Capability unit VIIe-3; woodland group 8.

Baywood Series

The Baywood series consists of somewhat excessively drained loamy sand that formed in wind-modified sandy coastal plain sediments and soft sandstone. These soils are on the Pacific Ocean terraces on the western edge of the county from Bodega Bay to the Gualala River. Slopes are 2 to 30 percent. Elevation ranges from 20 to 300 feet. Annual rainfall is 30 to 35 inches, the annual temperature is 52° to 56° F., and the frost-free season is 320 to 340 days. The vegetation is chiefly annual and perennial grasses. In some excessively windswept areas, however, rows of cypress and eucalyptus trees have been planted as windbreaks. The Baywood soils are associated with the Kinman, Kneeland, Rohnerville, and Sheridan soils.

In a typical profile the soil is very dark grayish-brown, dark-brown, and dark grayish-brown medium acid loamy sand and sand to a depth of 60 inches or more.

Baywood soils are used mainly for dryland pasture. In the past, a few areas were used for such crops as potatoes and peas.

Baywood loamy sand, 2 to 9 percent slopes (BaC).--This soil is on coastal benches. Most of the slopes are long and smooth. In most places the range in slope is from 2 to 5 percent.

Typical profile 400 feet southeast of the eastern end of a row of cypress trees, 50 feet west of Bodega Head Road (SW1/4 SE1/4, sec. 27, T. 5 N., R. 11 W.):

Ap--0 to 3 inches, very dark grayish-brown (10YR 3/2) loamy sand, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; medium acid (pH 6.0); clear, wavy boundary.

A11--3 to 31 inches, dark-brown (10YR 3/3) loamy sand, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky and nonplastic; common fine roots; medium acid (pH 5.7); diffuse, smooth boundary.

A12--31 to 56 inches, dark-brown (10YR 3/3) loamy sand, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; a few, medium, tubular pores; medium acid (pH 5.7); abrupt, irregular boundary.

C--56 to 60 inches, dark grayish-brown (10YR 4/2) sand, very dark grayish-brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; a few fine roots; a few, medium, tubular pores; medium acid (pH 5.7).

The texture ranges from sand to loamy sand. The A horizon ranges from dark brown to very dark grayish brown when moist. This horizon is medium acid to slightly acid. The C horizon ranges from dark grayish brown to very pale brown to yellow. Baywood soils have inclusions of shell material of less than 1 percent by volume.

Included in mapping are small areas of Sheridan coarse sandy loam and Rohnerville loam. Also included are small localized areas of rock outcrops.

Permeability is rapid. Runoff is very slow to slow, and the hazard of soil blowing is moderate. Fertility is low. The available water capacity is 4 to 5 inches.

This soil is used mainly for pasture. Some areas are used for grass and legumes. In the past, some areas of this soil were used for growing potatoes and peas. Capability unit IIIe-4.

Baywood loamy sand, 9 to 30 percent slopes (BaE).--This soil is similar to Baywood loamy sand, 2 to 9 percent slopes, but it is steeper. Most slopes are 9 to 15 percent. This soil is on the coastal terraces from Gualala to Bodega Head.

Included in mapping are occasional rock outcrops or old "sea stacks" of hard, finer-grained sandstone. These outcrops occur particularly on or near ridgetops. Also included in mapping are small areas of Sheridan coarse sandy loam and Rohnerville loam.

Runoff is slow to medium.

This Baywood soil is used mainly for pasture. In the past, some of this soil was used for growing potatoes. Capability unit VIe-4.

Blucher Series

The Blucher series consists of somewhat poorly drained loam, underlain by mixed sedimentary alluvium of stratified silt and clay. These soils are in basins along stream bottoms and on alluvial fans. They are mainly in the south-central part of the county in valley areas west of Petaluma and Sebastopol. Slopes are 0 to 5 percent. Elevation ranges from 50 to 300 feet. Annual rainfall is 25 to 50 inches, the annual temperature is 52° and 55° F., and the frost-free season is 250 to 270 days. The vegetation is chiefly annual and perennial grasses and forbs plus scattered areas of sedges and wild berry vines. Much of the soil has been cleared and cultivated and is used for dry and irrigated pasture and some row crops. The Blucher soils are associated with the Goldridge, Pagaro, and Steinbeck soils.

In a typical profile the surface layer is dark-gray, medium acid and neutral loam and silt loam about 20 inches thick. Below this is a layer of gray, moderately alkaline fine sandy loam. At a depth of about 34 inches and extending to a depth of 60 or more inches is dark-gray and gray, moderately alkaline and mildly alkaline, heavy silty clay loam, silty clay loam, and heavy silt loam.

Blucher soils are used mainly for dryland and irrigated pasture and for hay crops. A few better drained areas are used for row crops and apple orchards.

Blucher loam, 0 to 2 percent slopes (BhA).--This nearly level to very gently sloping soil is on alluvial fans, in valley basins, and on flood plains.

Typical profile 50 feet east of Sexton Road, 500 feet south of the junction of Sexton Road and Bodega Highway (NW1/4 SE1/4 sec. 5, T. 6 N., R. 9 W.); the profile was moist when examined:

Ap1--0 to 9 inches, dark-gray (10YR 4/1) loam, very dark brown (10YR 2/2) moist; strong, coarse, angular blocky structure; very hard, friable, nonsticky and slightly plastic; many very fine roots; many, very fine, interstitial pores; medium acid (pH 6.0); abrupt, wavy boundary.

Ap2--9 to 20 inches, dark-gray (10YR 4/1) silt loam that has common, fine, distinct, yellowish-brown mottles; when moist, very dark brown (10YR 2/2) and having common, fine, distinct, dark-brown mottles; massive; very hard, firm, plastic and nonsticky; a few very fine and fine roots and many medium roots; many, very fine, tubular pores and common, fine, tubular pores; neutral (pH 7.0); gradual, smooth boundary.

C1--20 to 34 inches, gray (10YR 5/1) fine sandy loam that has common, fine, distinct, yellowish-brown mottles; when moist, very dark gray (10YR 3/1) and having common, fine, distinct, dark-brown mottles; massive; hard, friable, nonsticky and nonplastic; a few very fine and fine roots and common medium roots; many, very fine and fine, tubular pores; moderately alkaline (pH 8.0); clear, smooth boundary.

IIA11b--34 to 45 inches, dark-gray (10YR 4/1) heavy silty clay loam that has a few, fine, distinct, dark yellowish-brown mottles; when moist, black (10YR 2/1) and having a few, fine, distinct, very dark grayish-brown mottles; massive; very hard, firm, sticky and plastic; a few very fine and fine roots and common medium roots; many, very fine, tubular pores, and common, fine, tubular pores; moderately alkaline (pH 8.0); gradual, smooth boundary.

IIA12b--45 to 57 inches, dark-gray (10YR 4/1) silty clay loam that has common, fine, prominent, dark yellowish-brown mottles; when moist, very

dark brown (10YR 2/2) and having common, fine, distinct, dark-brown mottles; massive; hard, friable, slightly sticky and plastic; a few very fine and fine roots; a few, very fine, tubular pores and common, fine, tubular pores; mildly alkaline (pH 7.8); gradual, smooth boundary.

IIC2--57 to 78 inches, gray (10YR 5/1) heavy silt loam that has common, medium, distinct, dark yellowish-brown mottles; dark yellowish-brown (10YR 3/4) moist with common, medium, distinct, dark-gray mottles; massive; hard, friable, nonsticky and slightly plastic; a few very fine roots; common, very fine and fine, tubular pores; mildly alkaline (pH 7.5); saturated below a depth of 72 inches.

The A horizon ranges from gray to very dark gray in color when dry, and from very dark brown to black when moist. The soil is granular in structure or massive, depending upon the degree of compaction. This horizon is medium acid to mildly alkaline. Mottles are distinct or prominent. The buried A horizons range from silty clay loam to clay in texture. These horizons are mildly alkaline to moderately alkaline. The C horizon ranges from sandy loam to silty clay loam in texture.

Included in mapping are small areas of Pajaro clay loam and Steinbeck loam and soils that slope as much as 5 percent.

Permeability is slow in the subsoil of this Blucher soil. Runoff is slow, and the hazard of erosion is slight. Fertility is moderately high. The available water capacity is 7 to 9 inches. The effective rooting depth to the water table is 40 to 50 inches.

This soil is used mainly for oat hay and row crops or for dryland and irrigated pasture. On nearly all areas of this soil, the original cover of grasses, sedges, and vines has been modified by use for cultivated crops or pasture. Some field corn is harvested for silage. The soil is not suited for tree crops, except for small family orchards on better drained areas. Capability unit IIw-2.

<u>Blucher loam, 2 to 5 percent slopes</u> (BhB).--This soil is similar to Blucher loam, 0 to 2 percent slopes, but the surface layer is gray and grayish brown and is somewhat more stratified with thin layers of fine sandy loam. Also, the finer textures in the buried horizons are 4 to 8 inches nearer the surface. This soil is gently sloping.

Included in mapping are small areas of Pajaro fine sandy loam and Steinbeck loam and soils that slope as much as 9 percent.

The available water capacity is 6 to 8 inches. Runoff is slow to medium, and the surface layer dries out soon after the rainy season. The effective rooting depth to the water table is 40 to 50 inches.

This soil is used mainly for producing oats or for producing oats and vetch for hay. Field corn is sometimes grown for silage. Capability unit IIw-2.

<u>Blucher clay loam, 0 to 2 percent slopes</u> (BlA).--This soil is similar to Blucher loam, 0 to 2 percent slopes, except that the surface layer is clay loam. There is less stratification in the surface layer because of the more uniform texture of the transported and deposited soil material.

Included in mapping are small areas of Pajaro fine sandy loam and Steinbeck loam and soils that slope as much as 5 percent.

The available water capacity is 8 to 10 inches, and the effective rooting depth to the water table is 45 to 60 inches.

This soil is used mainly for irrigated and dryland pasture. Some small areas are used for producing truck crops. The soil remains wet and cold until late in spring and short-season crops are well suited. Capability unit IIw-2.

<u>Blucher clay loam, 2 to 5 percent slopes</u> (BlB).--This soil is similar to Blucher loam, 0 to 2 percent slopes, but is gently sloping and has a surface layer of clay loam. It takes longer for this soil to dry and warm in the spring because of runoff and water seepage from adjacent higher slopes.

Included in mapping are small areas of Pajaro clay loam and Steinbeck loam, as well as soils that have slopes of 9 percent.

The available water capacity is 8 to 10 inches, and the effective rooting depth to the water table is 45 to 60 inches.

This soil is used mainly for annual pasture and for short-season crops. Capability unit IIw-2.

<u>Blucher fine sandy loam, overwash, 0 to 2 percent slopes</u> (BcA).--This soil is similar to Blucher loam, 0 to 2 percent slopes, but the surface has an overwash of fine sandy loam. Also, the surface layer of this soil is more stratified with thin layers of loam or light clay loam, and it is gray or brown in color. This soil is on fans at lower elevations, and it is subject to flooding by runoff. This Blucher soil remains wet longer after the rainy season.

Included in mapping are small areas of Pajaro fine sandy loam and Steinbeck loam. Also included are soils that have slopes of up to 5 percent.

The effective rooting depth to the water table is 50 to more than 60 inches. The available water capacity is 6 to 8.5 inches.

Nearly all of this soil is used for pasture or row crops. Spring planting dates are delayed until the soil dries and warms. Capability unit IIw-2.

Boomer Series

The Boomer series consists of well-drained loams that have a clay loam subsoil. These soils are underlain, at a depth of 30 to 60 inches, by greenstone and metamorphosed rocks. They are on mountainous uplands. They lie along the hills on the west side of Dry Creek, extending southerly along the west side of the Russian River, and also are scattered throughout the northern third of the county on both sides of the Russian River. There are other areas of Boomer soils in the hills at the north end of the Sonoma Valley. Slopes are 15 to 75 percent. Elevation ranges from 400 to 2,000 feet. Annual rainfall is 40 to 60 inches, annual temperature is 54° to 56° F., and the frost-free season is 230 to 250 days. The vegetation is chiefly Douglas-fir and redwood mixed with oak, madrone, and poison oak. A few areas have scattered grass and a low cover of shrubs. The Boomer soils are associated with the Henneke, Hugo, Josephine, Red Hill, and Stonyford soils.

In a typical profile the surface layer is brown and dark reddish brown, slightly acid loam about 19 inches thick. The subsoil is reddish-brown, slightly acid clay loam and gravelly clay loam about 36 inches thick. At a depth of about 55 inches is fractured basic igneous rock mixed with very gravelly clay loam.

Boomer soils are used mainly for Douglas-fir and redwood. Some areas have been cleared and are used for grazing.

Boomer loam, 50 to 75 percent slopes (BoG).--This very steep soil is on mountainous uplands. The slopes are long and smooth. In most places slopes range from 50 to 55 percent.

Typical profile at an elevation of 700 feet; slope of 62 percent that faces west; 7 miles northeast of Healdsburg (SE1/4 NW1/4 sec. 24, T. 10 N., R. 8 W.); the profile was dry to a depth of 19 inches and moist below when examined:

A1--0 to 11 inches, brown (7.5YR 5/4) loam, dark reddish brown (5YR 3/3) moist; strong, coarse, granular structure; hard, friable, slightly sticky and slightly plastic; many, micro, very fine, and coarse roots; many, micro, very fine, interstitial pores; slightly acid (pH 6.5); many large krotovinas; diffuse, irregular boundary.

A3--11 to 19 inches, reddish-brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) moist; massive; hard, friable, slightly sticky and slightly plastic; common fine and medium roots; many micro and very fine pores and a few fine pores; slightly acid (pH 6.5); diffuse boundary.

B21t--19 to 37 inches, reddish-brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; strong, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common very fine pores; continuous thin clay films as bridges and in pores; slightly acid (pH 6.5); diffuse boundary.

B22t--37 to 47 inches, reddish-brown (2.5YR 4/4) gravelly clay loam, dark reddish brown (2.5YR 3/4) moist; strong, medium, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; a few very fine and fine roots and common coarse roots; a few micro and fine pores; continuous, moderately thick clay films in pores and on ped faces; slightly acid (pH 6.5); gradual, irregular boundary.

B23t--47 to 55 inches, reddish-brown (2.5YR 4/4) gravelly clay loam, dark reddish brown (2.5YR 3/4) moist; strong, subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; a few very fine and fine roots and common coarse roots; a few micro and fine pores; continuous moderately thick clay films in pores and on ped faces; slightly acid (pH 6.5); gradual, irregular boundary.

R--55 inches, fractured, basic igneous rock mixed with reddish-brown (2.5YR 4/4) very gravelly clay loam, reddish brown (2.5YR 4/4) moist; continuous, moderately thick clay films in pores; slightly acid (pH 6.5).

In some areas there is a duff layer of conifer needles, oak leaves, and humus 1 or 2 inches thick. The B horizon is yellowish red or red and reddish brown. Reaction ranges from slightly acid to medium acid. Depth to rock ranges from 45 to 60 inches. The rock contains variable amounts of soil material and basic igneous materials other than greenstone.

Included in mapping are small areas of Hugo very gravelly loam, Josephine loam, and Red Hill clay loam, as well as soils that have slopes of less than 50 percent.

Permeability is moderate in the subsoil of this Boomer soil. Runoff is very rapid, and the hazard of erosion is very high. Fertility is moderate. The available water capacity is 7 to 10 inches. The effective rooting depth is 45 to 60 inches.

Cover is mainly conifers with mixtures of hardwood and an understory of shrubs. Much of the soil area has been logged, and the hardwood and shrub cover has increased. Some cleared areas are used for grazing and browse. Capability unit VIIe-1; woodland group 3.

Boomer loam, 15 to 30 percent slopes (BoE).--This soil is similar to Boomer loam, 50 to 75 percent slopes, but it is 30 inches to more than 60 inches deep over rock.

Included in mapping are small areas of Hugo very gravelly loam, Josephine loam, and Red Hill clay loam, as well as soils that have slopes of up to 50 percent.

The available water capacity is 6 to 10 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for producing timber. Some areas have been used for grazing. A few prune and walnut orchards have been planted, but their success has been limited. Capability unit IVe-1; woodland group 1.

Boomer loam, 30 to 50 percent slopes (BoF).--This soil is similar to Boomer loam, 50 to 75 percent slopes.

Included in mapping are small areas of Hugo very gravelly loam, Josephine loam, and Red Hill clay loam, as well as soils that have slopes of up to 60 percent.

Surface runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for producing timber and for limited grazing. Capability unit VIe-1; woodland group 2.

Caspar Series

The Caspar series consists of well-drained sandy loams that have a subsoil of clay loam and sandy clay loam. These soils formed in sedimentary marine terrace material. They are on rolling hills and mountainous uplands. They occur along the northwest coastal areas of the county, 0.5 to 5 miles inland, mainly in the vicinity of Timber Cove and Stewarts Point. Slopes are 15 to 50 percent. Elevation ranges from 200 to 1,000 feet. Annual rainfall is 35 to 45 inches, annual temperature is 54° to 56° F., and the frost-free season is 290 to 310 days. The vegetation is chiefly mixed conifers, such as Bishop pine, Douglas-fir, and redwood, with an understory of oak, baywood, tanoak, and madrone. An area of this soil south of Stewarts Point along the ocean has a combination of rhododendron shrubs and small trees mixed with the conifers. The Caspar soils are associated with the Empire, Goldridge, and Mendocino soils.

In a typical profile the surface layer is light-gray and white, strongly acid and very strongly acid sandy loam about 12 inches thick. The subsoil, to a depth of 60 inches or more, is very pale-brown and light yellowish-brown strongly acid and very strongly acid clay loam and sandy clay loam with yellowish-red mottles.

Caspar soils are used mainly for producing timber. Some areas have been cleared and are used for grazing.

Caspar sandy loam, 15 to 30 percent slopes (CaE).--This moderately steep soil is on uplands. Most of the slopes are short and abrupt.

Typical profile at an elevation of 300 feet; slope faces southeast; vegetation is Douglas-fir, redwood, and various understory plants; 1 mile west-northwest of Plantation on Kruse Park Road (NW1/4 SW1/4 sec. 29, T. 9 N., R. 13 W.); the profile was moist throughout when examined:

O1--1 inch to 0, coarse, slightly decomposed litter.

A21--0 to 6 inches, light-gray (10YR 6/1) and white (10YR 8/1) sandy loam, dark gray (10YR 4/1) moist; very weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, tubular and interstitial pores; strongly acid (pH 5.5); clear, smooth boundary.

A22--6 to 12 inches, light-gray (10YR 7/1) and white (10YR 8/1) sandy loam, grayish brown (2.5Y 5/2) moist; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, tubular and interstitial pores; very strongly acid (pH 5.0); abrupt, wavy boundary with tongues of A2 in and along root channels.

B21t--12 to 24 inches, very pale brown (10YR 7/4) clay loam that has pale-brown clay films; when moist, yellowish brown (10YR 5/4) and having brown clay films; strong, medium, angular blocky structure; slightly brittle, weakly cemented; some characteristics of fragipans; very firm, slightly sticky and plastic; a few fine and medium roots; common, very fine and fine, tubular and interstitial pores; common thin and moderately thick clay films as bridges; strongly acid (pH 5.5); clear, smooth boundary.

B22t--24 to 30 inches, very pale brown (10YR 7/4) clay loam; when moist, yellowish brown (10YR 5/6) and having common, medium, prominent yellowish-red mottles; massive; slightly hard, firm, sticky and plastic; a few fine and coarse roots; common, very fine and fine, tubular and interstitial pores; common thin and moderately thick clay films as bridges; strongly acid (pH 5.5); clear, smooth boundary.

B23t--30 to 60 inches, light yellowish-brown (10YR 6/4) heavy sandy clay loam, yellowish-brown (10YR 5/6) moist; strong coarse angular blocky structure; slightly hard, firm, sticky and very plastic; very few fine roots; a few fine tubular pores; continuous thick clay films on ped faces; very strongly acid (pH 5.0).

The A2 horizon ranges from dark brown to white in color and from 7 to 23 inches in thickness. The structure is weak or very weak granular or subangular blocky, or the soil is massive. The B2t horizon ranges from clay loam to sandy clay loam in texture and from 36 to more than 60 inches in thickness. Depth to unconsolidated siliceous sandstone is from 45 to over 60 inches.

Included in mapping are small areas of Empire loam and Mendocino sandy clay loam, as well as soils that have slopes of less than 15 percent.

Permeability is moderate in the subsoil. Runoff is medium to rapid, and the hazard of eroison is moderate to high. Fertility is moderate. The available water capacity is 9 to 11 inches.

This soil is used mainly for the production of timber. Capability unit VIe-1; woodland group 4.

Caspar sandy loam, 30 to 50 percent slopes (CaF).--This soil is similar to Caspar sandy loam, 15 to 30 percent slopes, but the surface layer is about 7 to 18 inches thick.

Included in mapping are small areas of Empire loam and Mendocino sandy clay loam, as well as soils that have slopes of up to 60 percent.

The available water capacity is 9 to 11 inches. Runoff is rapid, and the hazard of erosion is high.
This soil is used mainly for the production of timber. Capability unit VIe-1; woodland group 5.

Cibo Series

The Cibo series consists of well-drained clays underlain, at a depth of 30 to 55 inches, by strongly weathered, fine-grained, basic igneous rocks. These soils are on mountainous uplands. They are on hillsides and ridges surrounding the Russian River which flows through the north-central part of the county. Slopes are 15 to 50 percent. Elevation ranges from 400 to 2,500 feet. Annual rainfall is 40 to 60 inches, annual temperature is about 60° F., and the frost-free season is about 250 days. The vegetation is chiefly annual grasses, forbs, and scattered oaks. The Cibo soils are associated with the Boomer and Dibble soils.

In a typical profile dark-brown and dark yellowish-brown, slightly acid and neutral clay and gravelly clay extend to a depth of about 48 inches. At a depth of about 48 inches is decomposed and strongly weathered gabbro.

Cibo soils are used mainly for pasture and for grazing.

Cibo clay, 15 to 50 percent slopes (CbF).--This soil is on uplands. Most of the slopes are short and abrupt. In most places slopes range from 15 to 30 percent.

Typical profile in a pasture; convex slope of 28 percent that faces northwest; about 500 feet west of turnoff from West Side Road to MacMurrary Ranch Road and about 1,600 feet north to road cut (SW1/4 NE1/4 sec. 19, T. 8 N., R. 9 W.); the profile was dry when examined:

A11--0 to 11 inches, dark-brown (10YR 4/3) clay, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure but granular in upper 2 inches; slightly hard, friable, sticky and plastic; common fine roots; common, fine, tubular pores; common thin clay films in pores; slightly acid (pH 6.5); gradual, wavy boundary.

A12--11 to 27 inches, dark yellowish-brown (10YR 4/4) clay, dark brown (10YR 3/3) moist; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; common fine and medium roots; common slickensides; common, fine, tubular and interstitial pores; many moderately thick clay films in pores; neutral (pH 7.0); gradual, irregular boundary.

C1--27 to 48 inches, dark yellowish-brown (10YR 4/4) gravelly clay, dark brown (10YR 3/3) moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and plastic; a few fine roots; common, fine, tubular and interstitial pores; common slickensides; many moderately thick clay films in pores and on ped faces; neutral, (pH 7.0); about 15 percent gravel; gradual, irregular boundary.

C2--48 inches, variegated, strongly weathered gabbro that has some gravelly sandy clay; granular structure; friable, sticky and plastic; a few fine roots; a few, medium, tubular pores; continuous clay films in pores and on ped faces; neutral (pH 7.0); about 25 percent gravel. Seams of weathered parent material appear throughout the profile.

The A horizon ranges from dark gray and dark grayish brown to dark brown and dark yellowish brown in color. The percentage of gravel and stone varies from approximately 25 percent to very little. Depth to the C2 horizon varies from 30 to 55 inches.

Included in mapping are small areas of Boomer loam and Dibble clay loam, as well as soils that have a slope of less than 15 percent.

Permeability is slow in the subsoil of this Cibo soil. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is moderate. The available water capacity is 4 to 9 inches.

This soil is used mainly for pasture or range. Capability unit VIe-5; range site 3.

Clear Lake Series

The Clear Lake series consists of clays that formed under poorly drained conditions. These soils are underlain by alluvium from basic and sedimentary rock. They are on plains and flat basin areas. They occur in an area that extends from approximately 5 miles south of Santa Rosa and east of Petaluma to north of the tidelands bordering San Francisco Bay. There are also scattered areas south and southwest of the town of Sonoma. Slopes are 0 to 5 percent. Elevation ranges from 20 to 300 feet. Annual rainfall is 22 to 35 inches, the annual temperature is 58° to 60° F., and the frost-free season is 260 to 280 days. Where not cultivated, the vegetation is chiefly annual or perennial grasses and forbs. The Clear Lake soils are associated with the Haire, Huichica, Reyes, Wright, and Zamora soils.

In a typical profile the surface layer is a dark-gray, medium acid and slightly acid clay about 39 inches thick. This is underlain by a dark-gray, moderately alkaline clay that has light gray mottles. At a depth of about 46 inches is gray and light brownish-gray, moderately alkaline clay. At a depth of about 60 inches is light-gray to white, mildly alkaline sandy clay loam.

Clear Lake soils are used mainly for growing oat-vetch hay and oat hay for dairy and horse feed. A few small areas are used for irrigated pasture and row crops.

Clear Lake clay, 0 to 2 percent slopes (CeA).--This soil is in poorly drained basins and on flood plains. Most of the acreage is characterized by extremely long, smooth areas.

Typical profile in an oat-hay pasture on Dangers Ranch; slope of 1 percent; 0.5 mile southeast of the junction of Corona and Ely Road (NW1/4 NW1/4 sec. 21, T. 5 N., R. 7 W.):

Ap1--0 to 2 inches, dark-gray (N 4/0) clay, very dark gray (10YR 3/1) moist; fine and medium granular structure; hard, very firm, sticky and plastic; many fine, very fine, and micro roots; common, fine and very fine, interstitial pores; medium acid (pH 6.0), clear, wavy boundary.

Ap2-- 2 to 8 inches, dark-gray (N 4/0) clay, very dark gray (10YR 3/1) moist; massive and coarse subangular blocky structure; very hard, very firm, sticky and plastic; many, fine, very fine, and micro roots; many, fine and very fine, interstitial pores; medium acid (pH 6.0); clear, wavy boundary.

A11--8 to 25 inches, dark-gray (N 4/0) clay, black (10YR 2/1) moist; massive; extremely hard, extremely hard, extremely firm, sticky and plastic; many very fine and fine roots; common, very fine, tubular pores; many slickensides; medium acid (pH 6.0); gradual, smooth boundary.

A12--25 to 39 inches, dark-gray (N 4/0) clay that has common, fine, distinct, light-gray mottles; black (10YR 2/1) when moist; massive; extremely hard, extremely firm, sticky and plastic; many very fine and fine roots; common, very fine, tubular pores; many slickensides; slightly acid (pH 6.5); gradual, smooth boundary.

AC--39 to 46 inches, dark-gray (N 4/0) clay that has common, fine, distinct, light-gray mottles; black (10YR 2/1) when moist; massive; very hard, extremely firm, very sticky and plastic; common, very fine and micro roots; common, very fine, interstitial pores; many slickensides, moderately alkaline (pH 8.0); gradual, smooth boundary.

C1ca--46 to 52 inches, gray (N 5/0) clay that has common, fine, distinct, light-gray mottles; very dark grayish brown (10YR 3/2) when moist; massive; very hard, extremely firm, very sticky and very plastic; common, very fine and fine roots; common, very fine and fine, tubular pores; many slickensides; moderately alkaline (pH 8.0); scattered lime blotches; gradual, smooth boundary.

C2--52 to 60 inches, light brownish-gray (2.5Y 6/2) light clay that has white lime splotches; dark grayish brown (2.5Y 4/2) when moist; massive; very hard, extremely firm, sticky and plastic; a few very fine roots; common, very fine and fine, tubular pores; moderately alkaline (pH 8.0); large scattered lime blotches; clear, smooth boundary.

C3--60 to 72 inches, light-gray (10YR 7/2) to white (10YR 8/2) sandy clay loam, light olive gray (5Y 6/2) moist; massive; hard, firm, slightly sticky and slightly plastic; a few, fine, tubular pores and common, very fine and fine, interstitial pores; many moderately thick clay films in pores; moderately alkaline (pH 8.0); disseminated lime; weakly effervescent.

The A horizon ranges from dark gray to black in color and from strongly acid to neutral in reaction. The C horizon ranges from light brownish gray to gray to light gray and white in color and from clay to sandy clay loam in texture. Lime is usually encountered in the upper C horizon. The gravel content in the C horizon is variable but not more than 15 percent, by volume.

Included in mapping are small areas of Haire clay loam, Reyes silty clay, and Wright loam, as well as some soils that have slopes of up to 4 percent.

Permeability is slow. Runoff is slow, and the hazard of erosion is slight. Fertility is moderately high. The available water capacity is 8 to 10 inches. This Clear Lake soil is drained.

This soil is used mainly for producing oat-vetch hay or oat hay for feeding cattle and horses. Capability unit IIs-5.

Clear Lake clay, 2 to 5 percent slopes (CeB).--This soil is similar to Clear Lake clay, 0 to 2 percent slopes, but it is steeper and less lime is encountered in the lower part of the soil than in the surface layer.

Included in mapping are small areas of Haire clay loam, Huichica loam, and Wright loam. Also included are some soils that have slopes of less than 2 percent. Some included areas have slightly steeper slopes along drainageways and upper edges of fans.

This Clear Lake soil is drained.

This soil is used mainly for producing oat hay. Capability unit IIe-5.

Clear Lake clay, ponded, 0 to 2 percent slopes (CfA).--This soil is similar to Clear Lake clay, 0 to 2 percent slopes. The soil is in basinlike areas and is subject to temporary ponding. This soil is more difficult to work, and the surface does not dry so fast as in adjacent areas. Cultivation and planting is delayed following the rainy season.

Included in mapping are small areas of Huichica loam, Wright loam, and Zamora silty clay loam.

The main use of this soil is for the production of oat-vetch hay and oat hay. In the Laguna de Santa Rosa near Sebastopol, some areas of this soil are inundated and stay wet into late spring. Much of this area is used as pasture or is planted to sudangrass. Occasionally, field corn is grown for silage. Capability unit IIIw-5.

Clear Lake clay loam, 0 to 2 percent slopes (CcA).--This soil is similar to Clear Lake clay, 0 to 2 percent slopes, but it has a clay loam surface layer, 10 to 15 inches thick, underlain by clay. This soil is on the Russian River alluvium and alluvial fans in the Alexander Valley northwest of Healdsburg and on the edges of the large bodies of Clear Lake clay south and southeast of Santa Rosa.

Included in mapping are small areas of Huichica loam and Wright loam. Also included are some soils that have slopes of 2 to 5 percent.

This Clear Lake soil is drained.

The main use of the soil is for irrigated pasture and for producing prunes and oat hay. It is somewhat easier to work than Clear Lake clay, 0 to 2

percent slopes, because of the clay loam surface layer. Capability unit IIs-5.

Clear Lake clay loam, 2 to 5 percent slopes (CcB).--This soil is similar to Clear Lake clay, 0 to 2 percent slopes, but it is steeper and has a clay loam surface layer about 10 to 15 inches thick. This soil is located in the Alexander Valley northeast of Healdsburg, and in the southeastern Santa Rosa plains.

Included in mapping are small areas of Huichica loam and Wright loam. Also included are some soils that have slopes of less than 2 percent.

This Clear Lake soil is drained.

This soil is used mainly for irrigated pasture and for producing prunes and oat hay. Capability unit IIe-5.

Clough Series

The Clough series consists of moderately well drained gravelly loams that have a very gravelly clay subsoil. At a depth of 12 to 34 inches these soils are underlain by an indurated hardpan. These soils are on old bench terraces. They are in the valleys along and above stream and river channels, on undulating slopes north of Healdsburg between Dry Creek and the Russian River. Some areas are scattered through the Sonoma Valley area between Kenwood and the town of Sonoma. Slopes are 2 to 30 percent. Elevation ranges from 200 to 500 feet. Annual rainfall is 30 to 50 inches, the annual temperature is 60° to 62° F., and the frost-free season is 220 to 250 days. The vegetation is chiefly oaks, manzanita, poison oak, annual grasses, and forbs, but there are occasional patches of Douglas-fir and redwood. The Clough soils are associated with the Haire, Manzanita, and Positas soils.

In a typical profile the surface layer is light yellowish-brown and yellowish-brown, strongly acid gravelly loam about 10 inches thick. The subsoil is strong-brown, very strongly acid, very gravelly clay loam and reddish-yellow and gray, very strongly acid, very gravelly clay. At a depth of about 23 inches is an indurated hardpan. At a depth of about 38 inches is stratified cobbly and gravelly old alluvium.

Clough soils are used mainly for grazing. A few areas have been cleared and are used for grapes and prunes. There are some areas of irrigated pasture.

Clough gravelly loam, 2 to 9 percent slopes (CgC).--This soil is on bench terraces. In most places, the slopes range from 3 to 6 percent.

Typical profile 3 miles north of Healdsburg, west of Norton Sky Ranch (SE1/4 NW1/4 sec. 6, T. 9 N., R. 9 W.); the profile was slightly moist at a depth of 4 inches when examined:

A1--0 to 4 inches, light yellowish-brown (10YR 6/4) gravelly loam, brown (7.5YR 4/4) moist; massive; soft, friable, slightly sticky and slightly plastic; many micro and very fine roots and a few medium roots; many, very fine and fine, tubular and interstitial pores; common thin clay films in pores and bridges; strongly acid (pH 5.5); abrupt, wavy boundary.

A3--4 to 10 inches, yellowish-brown (10YR 5/4) gravelly loam; when moist, brown (7.5YR 4/4) and having common, fine, distinct, strong-brown mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many, very fine and fine, tubular and interstitial pores; many moderately thick clay films in pores and as bridges; strongly acid (pH 5.3); abrupt, wavy boundary.

B21t--10 to 18 inches, strong-brown (7.5YR 5/6) very gravelly clay loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable, sticky and plastic; common very fine roots and many fine roots; common, very fine and fine, tubular and interstitial pores; a few thin clay films in pores and as bridges; very strongly acid (pH 5.0); clear, wavy boundary.

B22t--18 to 23 inches, reddish-yellow (7.5YR 6/6) and gray (10YR 6/1) very gravelly clay; when moist, yellowish red (5YR 5/8) and having many, medium, prominent, light brownish-gray mottles; massive; slightly hard, friable, sticky and plastic; a few micro roots; many medium roots, and common coarse roots; many, fine, tubular and interstitial pores; common, moderately thick clay films in pores; very strongly acid (pH 5.0); abrupt, wavy boundary.

C1m--23 to 38 inches, strong-brown (7.5YR 5/6) and light-gray (10YR 6/1) indurated hardpan; when moist, light brownish gray (2.5Y 6/2) and having strong-brown mottles; massive; a few very fine roots; very strongly acid (pH 4.5).

C2--38 to 60 inches, stratified cobbly and gravelly old alluvium.

The A horizon ranges from grayish brown to yellowish brown to light yellowish brown to reddish brown in color. Gravel and stone fragments range from 15 to 35 percent. The B horizon ranges from strong brown to reddish brown or reddish yellow in color. Gravel and stone fragments make up 35 to 60 percent of the B horizon.

Depth to the consolidated C1m horizon varies from about 20 to 34 inches.

Included in mapping are small areas of Manzanita gravelly silt loam and Positas gravelly loam. Also included are soils that have slopes of less than 2 percent.

Permeability is very slow in this Clough soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is moderate. The available water capacity is 3.5 to 4.5 inches.

Some areas of this soil are used for grapes and hay. Other areas are used for range and grazing. Capability unit IIIe-3, range site 4.

Clough gravelly loam, 9 to 15 percent slopes (CgD).--This soil is similar to Clough gravelly loam, 2 to 9 percent slopes, but it is steeper and is 16 to 21 inches deep over the cemented hardpan.

Included in mapping are small areas of Haire gravelly loam and Positas gravelly loam. Also included are some soils that have slopes of less than 9 percent.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 2.5 to 3.5 inches.

The uses of this Clough soil are similar to those of Clough gravelly loam, 2 to 9 percent slopes. Some areas are used for grapes and hay. Other areas are used for range and grazing. Capability unit IVe-3; range site 4.

Clough gravelly loam, 15 to 30 percent slopes (CgE).--This soil is similar to Clough gravelly loam, 2 to 9 percent slopes, but it is steeper and is 12 to 18 inches deep over the hardpan. The subsoil of this Clough soil contains up to 70 percent gravel and small stones.

Included in mapping are small areas of Haire gravelly loam and Positas gravelly loam, as well as some soils that have slopes of up to 35 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 2 to 3 inches.

Nearly all of this soil is used as range. Capability unit VIe-3; range site 4.

Coastal Beaches

Coastal beaches (ChA) is a miscellaneous land type which consists of narrow, sandy beaches that are covered or nearly covered during high tide and exposed during low tide. They occur where the rocky and sandy areas of the Pacific Ocean meet the Sonoma County coast. Parts of the coast consist of narrow beaches backed by bluffs that are 10 to 250 feet high. In some areas the bluffs rise abruptly from the sea. The beaches have no agricultural value but are used for recreation such as camping, picnicking, surf fishing, and clam and abalone hunting. Capability unit VIIIw-4.

Cohasset Series

The Cohasset series consists of well-drained gravelly loams that have a gravelly clay loam subsoil and, at a depth of 20 to 60 inches, are underlain by weathered andesitic basalt and breccia of volcanic origin. These soils are on wooded, mountainous uplands. They occur on Mt. St. Helena and also 2 to 5 miles east of the Alexander Valley. Slopes are 15 to 75 percent. Elevation ranges from 800 to 3,300 feet. Annual rainfall is 40 to 70 inches, the annual temperature is 54° to 56° F., and the frost-free season is 220 to 250 days. The vegetation is chiefly a mixture of conifers and hardwood, but much of the area has been logged or burned over. There are some small patches of grassy glades. Where trees have been removed, a few areas have been invaded by forbs and brushy shrubs. The Cohasset soils are associated with the Forward, Kidd, Red Hill, Supan, and Toomes soils.

In a typical profile the surface layer is about 9 inches of brown and light yellowish-brown, slightly acid gravelly loam and about 10 inches of light-brown medium acid gravelly loam. The subsoil is light-brown strongly acid gravelly clay loam. At a depth of about 29 inches is weathered volcanic rocks such as andesitic tuff and breccia.

Cohasset soils are used mainly for Douglas-fir and redwood. A few areas have been cleared and are used for grazing.

Cohassett gravelly loam, 30 to 50 percent slopes (CmF).--This steep soil is on uplands.

Typical profile on a north-northwesterly facing burned hillside; slope of 31 percent that faces north-northwest; supports manzanita brush, a few scattered burned stumps of Douglas-fir and tanoak; located 2 miles northwest of St. Helena lookout on Ida Clayton Road north of Knights Valley (NE1/4 sec. 29, T. 10 N., R. 7 W.):

A1--0 to 9 inches, brown (7.5YR) and light yellowish-brown (10YR 6/4) gravelly loam, reddish brown (5YR 4/4) moist; moderate, medium, granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common, fine, tubular pores; slightly acid (pH 6.5); 5 percent gravel; diffuse, smooth boundary.

A3--9 to 19 inches, light-brown (7.5YR 6/4) gravelly loam, yellowish red (5YR 3/5) moist; massive; soft, very friable, sticky and nonplastic; a few fine and medium roots; common, fine, tubular pores; common thin clay films on mineral grains; medium acid (pH 6.0); 10 percent gravel by volume; gradual, smooth boundary.

B2t--19 to 29 inches, light-brown (7.5YR 6/4) gravelly clay loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, sticky and plastic; a few medium roots; many, fine, tubular pores; many moderately thick clay films in pores; strongly acid (pH 5.5); 20 percent gravel by volume; gradual, wavy boundary.

R--29 inches, weathered volcanic rocks such as andesitic tuff and breccia.

Depth to weathered rock ranges from 28 to 60 inches, and gravel content varies from 5 percent to approximately 30 percent, by volume.

Included in mapping are small areas of Forward gravelly loam, Kidd gravelly loam, and Red Hill clay loam, as well as some Cohasset soils that have slopes of less than 30 percent.

Permeability in the subsoil of this Cohasset soil is moderate. Runoff is rapid, and the hazard of erosion is high. Fertility is moderate, and the available water capacity is 5 to 9 inches.

Much of this soil has been logged and burned over. Some areas have been used for grazing. Capability unit VIe-1; woodland group 5.

Cohasset gravelly loam, 15 to 30 percent slopes (CmE).--This soil is similar to Cohasset gravelly

loam, 30 to 50 percent slopes, but it is less steep and the depth to weathered rock varies from 45 to 60 inches.

Included in mapping are small areas of Red Hill clay loam, Supan silt loam, and Toomes rocky loam, as well as soils that have slopes of less than 15 percent.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 7 to 9 inches.

This soil is used mainly for timber. Attempts have been made to clear the lower slopes for occasional farming enterprises. Some cleared areas are used for family orchards and small vineyards. There has also been limited grazing. Capability unit IVe-1; woodland group 1.

Cohasset gravelly loam, 50 to 75 percent slopes (CmG).--This soil is similar to Cohasset gravelly loam, 30 to 50 percent slopes. Depth to weathered rock ranges from 20 to 35 inches. This very steep soil is subject to erosion on the steeper slopes.

Included in mapping are small areas of Forward gravelly loam, Kidd gravelly loam, and Toomes rocky loam.

Runoff is very rapid, and the hazard of erosion is very high. The available water capacity is 4 to 6 inches.

This soil is used mainly for timber and limited grazing. Capability unit VIIe-1; woodland group 9.

Cole Series

The Cole series consists of somewhat poorly drained silt loams that have a dominantly clay subsoil. These soils formed in alluvium from mixed sedimentary and basic rock. These soils are on alluvial fans. They are mainly in the Alexander Valley along both sides of the Russian River and on its flood plains. Slopes are 0 to 5 percent. Elevation ranges from 250 to 400 feet. Annual rainfall is 40 to 50 inches, the annual temperature is 59° to 61° F., and the frost-free season is 250 to 270 days. Where not cultivated, vegetation is chiefly grass and scattered oak trees with some wild berry vines and low-growing shrubs. The Cole soils are associated with the Cortina, Yolo, and Zamora soils.

In a typical profile the surface layer is grayish-brown, slightly acid silt loam and light silty clay loam about 18 inches thick. Below this is grayish-brown, neutral light silty clay loam about 13 inches thick. The subsoil, to a depth of 60 inches and more, is grayish-brown and pale-brown, neutral and mildly alkaline silty clay loam and clay.

Cole soils are used mainly for prune and pear orchards and for vineyards. A few irrigated areas are used for producing hay, for pasture, and for row crops.

Cole silt loam, 0 to 2 percent slopes (CnA).--This level to nearly level soil has some depressional areas.

Typical profile in Fredsen's orchard, 2,600 feet north of junction of Lytton Spring Road and Hassett Lane and 75 feet west of Hassett Lane (NE1/4 SW1/4, sec. 33, T. 10 N., R. 9 W.):

Ap--0 to 8 inches, grayish-brown (2.5Y 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure and strong, very fine, granular structure; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many, fine, tubular pores; slightly acid (pH 6.5); abrupt, smooth boundary.

A1--8 to 18 inches, grayish-brown (2.5Y 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure and strong, very fine, granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots; many, fine and very fine, tubular pores; slightly acid (pH 6.5); gradual, smooth boundary.

A3--18 to 31 inches, grayish-brown (2.5Y 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; strong, very fine, granular structure; very hard, friable, slightly sticky and slightly plastic; common fine roots; many, fine and very fine, tubular and interstitial pores; thin patchy clay films; neutral (pH 6.7); gradual, smooth boundary.

B1--31 to 45 inches, mixed grayish-brown (10YR 5/2) and pale-brown (10YR 6/3) silty clay loam; when moist, dark grayish brown (10YR 4/2) and having common, medium, faint, dark yellowish-brown mottles; strong, very fine, granular structure; very hard, friable, slightly sticky and slightly plastic; common fine roots; common, fine and very fine, tubular pores; thin continuous clay films on peds and in pores; neutral (pH 6.7); clear, smooth boundary.

B2t--45 to 66 inches, pale-brown (10YR 6/3) clay that has streaks of light grayish-brown and light yellowish-brown; when moist, dark grayish brown (10YR 4/2) and having common, medium, faint, dark yellowish-brown (10YR 4/4) mottles; massive; very hard, firm, sticky and plastic; a few very fine roots; common, very fine, tubular and interstitial pores; mildly alkaline (pH 7.5).

The A horizon dry colors range from brown to grayish brown. Depth to the clay B horizon ranges from 30 to 45 inches.

Included in mapping are small areas of Yolo gravelly loam and Zamora silty clay loam. Some soil areas are subject to minor inundation for short periods, usually less than 2 days at a time.

Permeability is slow in the subsoil of this Cole soil. Runoff is slow, and the hazard of erosion is slight. Fertility is high. The available water capacity is 9 to 11 inches. There is a seasonal high water table at a depth of 1 to 4 feet. When drained, the effective rooting depth is more than 60 inches.

This soil is used mainly for prune and pear orchards and for vineyards. Some areas are used for pasture. Capability unit IIw-2.

Cole silt loam, 2 to 5 percent slopes (CnB).--This soil is similar to Cole silt loam, 0 to 2 percent slopes, but it is steeper. This soil may be more channeled than Cole silt loam, 0 to 2 percent slopes.

Included in mapping are small areas of Cortina very gravelly loam and Yolo gravelly loam.

This soil is used mainly for prune orchards. Some areas are used for vineyards and pasture. Recently, more acreage has been planted in pear orchards. Capability unit IIw-2.

Cole clay loam, 0 to 2 percent slopes (CoA).--This soil is similar to Cole silt loam, 0 to 2 percent slopes, but it has a clay loam surface layer. It is not subject to erosion by water but is inundated by overflow from the Russian River and adjacent drainageways. This Cole soil, which is often wet until late in spring, is nearly level with some depressed areas.

Included in mapping are small areas of Yolo silt loam and Zamora silty clay loam. Some included areas are subject to minor inundation for short periods, generally less than 2 days at a time.

Runoff is very slow, and the hazard of erosion is none to slight.

This soil is used primarily for annual pasture. Some areas are used for prune orchards and for vineyards. Capability unit IIw-2.

Cole clay loam, 2 to 5 percent slopes (CoB).--This soil is similar to Cole silt loam, 0 to 2 percent slopes, but it has a clay loam surface layer. Where this soil grades into the Zamora soils, the surface color tends to be dark grayish brown. Included in mapping are small areas of Cortina very gravelly sandy loam and Yolo clay loam.

The soil is used primarily for annual pasture, irrigated pasture, and for prune and pear orchards. Capability unit IIw-2.

Comptche Series

The Comptche series consists of well-drained gravelly loams that have a gravelly clay loam and clay subsoil. At a depth of 30 to 50 inches, these soils are underlain by basic igneous rock and weathered greenstone. These soils are on mountainous uplands. They are in small areas scattered in the north-central part of the county, generally to the east of the Russian River valley. Slopes range from 30 to 75 percent. Elevation ranges from 350 to 1,000 feet. Annual rainfall is 45 to 60 inches, the annual temperature is 60° to 62° F., and the frost-free season is about 250 to 270 days. The vegetation is chiefly Douglas-fir and redwood, but a few cleared areas have a cover of grass or grass and oak trees. The Comptche soils are associated with the Boomer, Hugo, Sobrante, and Stonyford soils.

In a typical profile the surface layer is reddish-gray, medium acid and strongly acid gravelly loam and gravelly clay loam about 8 inches thick. The subsoil is reddish-gray and weak-red, strongly acid gravelly clay loam and gravelly clay that is underlain by weathered greenstone at a depth of about 48 inches.

Comptche soils are used mainly for growing Douglas-fir and redwood. A few small areas have been cleared and are used for limited grazing by sheep and cattle.

Comptche gravelly loam, 20 to 75 percent slopes (CpG).--This steep soil is in small areas in the northern half of the county. Slopes are dominantly 40 to 60 percent.

Typical profile in a road cut on the road leading to the Dry Creek Rancheria (Indian reserve); slope of 63 percent that faces southeast; 2.7 miles east of Geyserville (NE1/4 NE1/4 sec. 21, T. 10 N., R. 9 W.); the profile was dry when examined:

01--1 1/2 inches to 0, mixed litter and gravel.

A11--0 to 3 inches, reddish-gray (2.5YR 5/1) gravelly loam, dusky red (2.5YR 3/2) moist; moderate, medium, granular structure and strong, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine and medium roots; many very fine, fine, and medium, tubular and interstitial pores; medium acid (pH 6.0); clear, smooth boundary.

A12--3 to 8 inches, reddish-gray (2.5YR 5/1) gravelly clay loam, dusky red (2.5YR 3/2) moist; weak and moderate fine and medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine and medium roots; common, very fine and fine, tubular and interstitial pores; strongly acid (pH 5.5); gradual, smooth boundary.

B1--8 to 26 inches, reddish-gray (10YR 5/1) gravelly clay loam, dusky red (10YR 3/2) moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; a few fine, medium, and coarse roots; common, fine and medium, interstitial pores; common thin clay films on ped faces and in pores; strongly acid (pH 5.5); diffuse boundary.

B21t--26 to 38 inches, weak-red (10YR 5/2) gravelly clay loam, dusky red (10YR 3/2) moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; a few fine, medium, and coarse roots; a few fine and medium interstitial pores; common thin clay films on ped faces; strongly acid (pH 5.5); clear boundary.

B22t--38 to 48 inches, weak-red (10R 4/2) gravelly light clay, dusky red (10R 3/3) moist; weak, coarse, subangular blocky structure; hard, very firm, slightly sticky and plastic; a few fine, medium, and coarse roots; a few, fine

and medium interstitial pores; continuous moderately thick clay films on ped faces and in pores; strongly acid (pH 5.5); gradual, irregular boundary.

R--48 inches, weathered, shattered greenstone mixed with varying amounts of soil material.

Depth to bedrock ranges from 30 to 50 inches. Gravel content ranges from 20 to 30 percent by volume.

Included in mapping are small areas of Boomer loam, Sobrante loam, and Stonyford gravelly loam.

Permeability in the subsoil of this Comptche soil is moderately slow. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Fertility is moderate, and the available water capacity is 5 to 7 inches.

This soil is used mainly for the production of timber, but some areas are used for grazing. Capability unit VIIe-1; woodland group 3.

Cortina Series

The Cortina series consists of excessively drained, very gravelly and sandy loams formed in recently deposited alluvium from mixed sedimentary and basic rock. These soils are on channeled stream bottoms. They are mainly in the north-central part of the county along the alluvial plains of the Russian River and Dry Creek and other drainageways. Slopes are 0 to 2 percent. Elevation ranges from 100 to 400 feet. Annual rainfall is 35 to 50 inches, annual temperature is 60° to 62° F., and the frost-free season is 250 to 270 days. Where not cultivated, vegetation is chiefly annual grasses, wild berry vines, willows, and small shrubs. The Cortina soils are associated with the Cole, Pajaro, and Yolo, and Zamora soils.

In a typical profile the surface layer is grayish-brown, medium acid and slightly acid very gravelly loam about 7 inches thick. The underlying layers, to a depth of 60 inches and more, are dark grayish-brown and grayish-brown, medium acid and slightly acid very gravelly sandy loam.

Cortina soils are used mainly for orchards, vineyards, and pasture.

Cortina very gravelly loam, 0 to 2 percent slopes (CsA).--This nearly level soil is close to major stream channels on flood plains. Nearly all places are subject to inundation by runoff from winter rains. This results in minor deposition and removal of various soil material.

Typical profile in a vineyard 1 mile northeast of Cloverdale; on a flood plain near the east bank of the Russian River (NW1/4 SW1/4 sec. 8, T. 11 N., R. 10 W.):

Ap--0 to 7 inches, grayish-brown (2.5Y 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; cloddy; soft, friable, slightly sticky and nonplastic; many micro and very fine roots; many, very fine, tubular and interstitial pores; medium acid (pH 5.7); abrupt, wavy boundary.

C1--7 to 17 inches, dark grayish-brown (10YR 4/2) very gravelly sandy loam, very dark gray (10YR 3/1) moist; massive; soft, very friable, slightly sticky and nonplastic; common very fine and fine roots; many, very fine, tubular and interstitial pores; continuous thin clay films as bridges; medium acid (pH 5.8); clear, wavy boundary.

C2--17 to 27 inches, grayish-brown (10YR 5/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many medium and very fine and fine roots; many, very fine and fine, interstitial pores; common, fine, tubular pores; continuous thin clay films as bridges; medium acid (pH 6.0); clear, wavy boundary.

C3--27 to 60 inches, grayish-brown (10YR 5/2) very gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky and nonplastic; many medium roots and common very fine and fine roots; common, fine, tubular and interstitial pores; slightly acid (pH 6.2).

The A horizon ranges from grayish brown to pale brown in color. The material is gravelly or very gravelly and texture ranges from loamy sand or sandy loam to loam. The lower C horizon ranges from 50 to about 90 percent gravel with little or no soil material other than coarse sandy loam and sand. Reaction ranges from medium acid to neutral throughout the profile. Stratification is common in many areas.

Included in mapping are small areas of Cole silt loam, Yolo sandy loam, overwash, and Zamora silty clay loam. Also there are some areas of riverwashed sand and gravel.

Permeability is very rapid in this Cortina soil. Runoff is slow, and the hazard of erosion is slight. Fertility is low. The available water capacity is 2 to 4 inches. The effective rooting depth is more than 60 inches.

After the rainy season annual grasses and volunteer legumes provide dryland pasture forage for a short time, but when this droughty soil dries out, the plants go to seed. When irrigation water is available, some areas are used for vineyards and pear orchards. Capability unit IVs-4.

Cortina very gravelly sandy loam, 0 to 2 percent slopes (CrA).--This soil is similar to Cortina very gravelly loam, 0 to 2 percent slopes, but has a very gravelly sandy loam surface layer. This soil is subject to frequent deposition and removal resulting from overflow from adjacent rivers and creeks.

Included in mapping are small areas of Cole silt loam, Yolo sandy loam, and riverwashed sand and gravel.

Some of this soil is used for vineyards and orchards when irrigation water is available, but most of it is used for dryland and irrigated pasture. Capability unit IVs-4.

Cotati Series

The Cotati series consists of moderately well-drained fine sandy loams that have a clay subsoil. They formed in weakly consolidated sand, gravel, and clay of old marine-terrace material and weathered siltstone and shale with occasional strata of weakly consolidated conglomerate. These soils are on undulating to hilly terraces. They occur mainly in the south-central part of the county between Petaluma and Cotati. Slopes are 2 to 30 percent. Elevation ranges from 100 to 400 feet. Annual rainfall is 25 to 30 inches, annual temperature is 54° to 56° F., and the frost-free season is about 240 to 260 days. When not cultivated, the vegetation is chiefly grasses, forbs, and scattered oaks. The Cotati soils are associated with the Clear Lake, Goldridge, Pajaro, Steinbeck, and Sebastopol soils.

In a typical profile the surface layer is light brownish-gray, grayish-brown, and light-gray, strongly acid fine sandy loam and sandy loam about 22 inches thick. The subsoil is grayish-brown to light-gray, very strongly acid and extremely acid clay about 33 inches thick. The substratum, at a depth of 55 inches, is light-gray, very strongly acid clay and softly consolidated marine sediment and sandstone.

Cotati soils are used mainly for dryland and irrigated pasture. A few areas are still used for chicken ranches, and some places are used for homesites.

Cotati fine sandy loam, 2 to 9 percent slopes (CtC).--This gently to moderately sloping soil is generally on the broad tops of low rolling hills. Much of the area that is located 2 to 3 miles west and northwest of Petaluma ranges in slope from 2 to 5 percent.

Typical profile in a pasture of heavily grazed annual grass; slope of 4 percent that faces southeast; 2.5 miles northwest of Cotati on Maffia Brothers Ranch, about 200 feet northwest of junction of driveway and Gravenstein Highway (NW1/4 NW1/4 sec. 28, T. 6 N., R. 8 W.); the profile was moist below a depth of 22 inches when examined:

Ap--0 to 5 inches, light brownish-gray (10YR 6/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure to a depth of 1 inch, massive structure below and apparent compaction by livestock; hard, friable, slightly sticky and nonplastic; many very fine roots and a few fine roots; common, very fine, interstitial pores; strongly acid (pH 5.5); clear, wavy boundary.

A11--5 to 11 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and nonplastic; many very fine roots and a few fine roots; many, very fine, tubular pores and many, very fine and fine, interstitial pores; common worm casts; strongly acid (pH 5.3); clear, wavy boundary.

A12--11 to 19 inches, light brownish-gray (2.5Y 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many, very fine, tubular pores and many, very fine and fine, interstitial pores; common worm casts; some mixing of material from A2 into this horizon by worm activity; strongly acid (pH 5.1); clear, wavy boundary.

A2--19 to 22 inches, light-gray (5Y 7/2) sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many, very fine roots, and a few fine roots; many, very fine, tubular pores and many, very fine and fine, interstitial pores; common worm casts; some mixing of material from A1 into this horizon by worm activity; strongly acid (pH 5.3); abrupt, wavy boundary.

B21t--22 to 35 inches, grayish-brown (10YR 5/2) clay, light olive brown (2.5Y 5/4) moist; moderate, coarse, prismatic structure; very hard, very firm, sticky and very plastic; many very fine roots in upper part of horizon; many, very fine, tubular pores; continuous moderately thick and thick clay films on ped faces and in tubular pores; common compression faces and slickensides; very strongly acid (pH 4.5); gradual, wavy boundary.

B22t--35 to 48 inches, light brownish-gray (2.5Y 6/2) clay, pale olive (5Y 6/3) moist; strong, coarse, prismatic structure, prisms break diagonally along slickenside planes; very hard, firm and very firm, sticky and very plastic; a few very fine exped roots; common, very fine, tubular pores; moderately thick clay films in pores and on ped faces; common compression faces and slickensides; extremely acid (pH 4.0); clear, wavy boundary.

B3t--48 to 55 inches, light-gray (2.5Y 7/2) clay, olive (5Y 5/3) moist; massive; very hard, friable and firm, very sticky and very plastic; a few very fine exped roots; a few very fine tubular pores; thick clay films in pores; a few slickensides; extremely acid (pH 4.2); gradual, wavy boundary.

C--55 to 68 inches, light-gray (5Y 7/1) clay; when moist, olive gray (5Y 5/2) and having streaks of dark brown (10YR 3/3); weak, medium and coarse, subangular blocky structure; very hard, firm with friable inclusions, very sticky and plastic; common, very fine, tubular pores; common moderately thick to thick clay films in pores and as bridges; very strongly acid (pH 4.5); a few brittle zones in this horizon indicate irregular transition to weakly consolidated shale of siltstone.

The A horizon ranges from 20 to 36 inches in thickness. The B horizon ranges from 25 to 36 inches in thickness. Depth to the underlying soft sandstone ranges from 45 to more than 60 inches.

Included in mapping are small areas of Goldridge fine sandy loam, Pajaro fine sandy loam, and

Steinbeck loam. Also included are small areas with a surface layer that ranges from 8 to 20 inches in thickness. Scattered, small areas of Cotati soils have varying amounts of highly polished quartz gravel throughout the soil.

Permeability is slow in the subsoil of this Cotati soil. Runoff is medium, and the hazard of erosion is moderate. Fertility is low. The available water capacity is 4 to 6 inches. The effective rooting depth is 20 to 36 inches for those crops which have difficulty penetrating the slowly permeable subsoil.

This soil is used mainly for pasture. Capability unit IIIe-3; range site 2.

Cotati fine sandy loam, 9 to 15 percent slopes (CtD).--This soil is similar to Cotati fine sandy loam, 2 to 9 percent slopes, but the surface layer is 20 to 24 inches thick, and the clay subsoil is 6 to 8 inches thinner.

Included in mapping are small areas of Goldridge fine sandy loam and Steinbeck loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 5 inches.

This soil is used mainly for grazing. There are a few small chicken ranches and oat-vetch hay is grown in a few areas. Capability unit IVe-3; range site 2.

Cotati fine sandy loam, 15 to 30 percent slopes (CtE).--This soil is similar to Cotati fine sandy loam, 2 to 9 percent slopes but the surface layer is about 18 to 24 inches thick, and the subsoil is about 10 to 28 inches thick.

Included in mapping are small areas of Goldridge fine sandy loam and Sebastopol sandy loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 3 to 5 inches.

This soil is used mainly for pasture. Capability unit VIe-3; range site 2.

Diablo Series

The Diablo series consists of well-drained clay soils. At a depth of 25 to more than 60 inches the soils overlie interbedded calcareous fine-grained sandstone, clayey shale, and weathered siltstone. These soils are on terraces and rolling uplands. They are mainly in the south-central quarter of the county on the open grass hills west of Sonoma Valley and east of the Petaluma plains. Slopes are 2 to 50 percent. Elevation ranges from 200 to 1,200 feet. Annual rainfall is 22 to 35 inches, annual temperature is 58° to 60° F., and the frost-free season is 260 to 290 days. Where not cultivated, the vegetation is chiefly annual and perennial grasses and scattered oaks. The Diablo soils are associated with the Clear Lake, Haire, and Raynor soils.

In a typical profile the surface layer is dark-gray and very dark gray, slightly acid and moderately alkaline clay about 30 inches thick. The next layer is dark-gray, moderately alkaline clay. At a depth of about 38 inches, is light olive-gray, moderately alkaline clay that extends to a depth of more than 60 inches.

Diablo soils are used mainly for pasture. A few of the less sloping and ridgetop areas are used for hay crops. The soils in this series are subject to land slippage, especially those that have steep slopes.

Diablo clay, 9 to 15 percent slopes (DbD).--This strongly sloping soil is on rolling hills. In most places, the slopes are long and smooth.

Typical profile in a grazed hayfield in good condition; slightly concave slope of 14 percent that faces southeast; on Sartori's Ranch 1,600 feet west and 1,000 feet south of the northernmost water tank on Manor Lane (SW1/4 NW1/4 sec. 13, T. 5 N., R. 7 W.); the profile was dry to a depth of 19 inches when examined:

Ap--0 to 7 inches, dark-gray (N 4/0) clay, very dark gray (10YR 3/1) moist; strong, fine, subangular blocky structure that grades with depth to weak, coarse, subangular blocky structure; very hard, firm, very sticky and very plastic; many very fine and fine roots; many, very fine and fine, interstitial pores; slightly acid (pH 6.5); abrupt, wavy boundary.

A11--7 to 19 inches, very dark gray (N 3/0) clay that has common, fine, distinct, light-gray mottles; black (10YR 2/1) moist; massive; extremely hard, extremely firm, very sticky, and very plastic; many very fine and fine roots; common, very fine, tubular pores; slightly acid (pH 6.5) with a few small scattered lime concretions; gradual, smooth boundary.

A12--19 to 30 inches, dark-gray (5Y 4/1) clay, very dark grayish brown (2.5Y 3/2) moist; weak, fine, subangular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; common, fine, tubular pores; moderately alkaline (pH 8.0); a few small lime concretions and blotches; gradual, smooth boundary.

AC--30 to 38 inches, dark-gray (N 4/0) clay that has many, medium, distinct, white mottles; olive gray (5Y 4/2) moist; massive; extremely hard, very firm, very sticky and very plastic; a few very fine roots; common, very fine, tubular pores; moderately alkaline (pH 8.0); scattered fine and medium lime blotches; common slickensides; gradual, smooth boundary.

C1--38 to 46 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) moist; massive; extremely hard, very firm, very sticky and very plastic; a few very fine roots; common, very fine and fine, tubular pores; moderately alkaline (pH 8.0); scattered lime blotches; some tonguing of A horizon material; a few slickensides; gradual, wavy boundary.

C2--46 to 56 inches, light olive-gray (5Y 6/2) light clay, olive-gray (5Y 4/2) moist; massive; extremely hard, firm, sticky and plastic; very fine roots; common, very fine and fine, tubular pores; moderately alkaline (pH 8.0); a few large streaks of lime mixed with black material; fragments of weathered siltstone which break to medium subangular blocky structure; gradual, irregular boundary.

C3--56 to 73 inches, light olive-gray (5Y 6/2) clay, olive-gray (5Y 4/2) moist; massive; extremely hard, firm, very sticky and very plastic; very fine roots; common, very fine and fine, tubular pores; moderately alkaline (pH 8.0); large blotchy lime areas; many slickensides; small fragments of weathered siltstone.

The A horizon ranges from gray to very dark gray in color. Quantity and size of tonguing of the A horizon into the C horizon varies considerably over short distances. Flecks and blotches of lime are in the A horizon at depths ranging from 7 to 18 inches. The number and size of slickensides vary in the A and C horizons, but are nearly always discernible. Weathered sandstone, shale, or siltstone occur at depths of 40 inches to more than 60 inches.

Included in mapping are small areas of Clear Lake clay, Haire clay loam, and Raynor clay.

Permeability is slow. Runoff is medium, and the hazard of erosion is moderate. Fertility is moderately high. The available water capacity is 6 to 9 inches. The surface layer has deep, irregular cracks upon drying. The effective rooting depth is 40 to more than 60 inches. Land slippage is a concern to management in some areas of this soil.

Much of the soil on the lower slopes is used for producing oat hay or grain, and also oat-vetch hay. Other areas are used for range. Capability unit IIIe-5; range site 3.

Diablo clay, 2 to 9 percent slopes (DbC).--This soil is similar to Diablo clay, 9 to 15 percent slopes, but lime is generally closer to the surface than on the steeper slopes, and the surface layer is gray.

Included in mapping are small areas of Clear Lake clay, Haire clay loam, and Raynor clay.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

The main use of this soil is for oat hay and oat-vetch hay. Lower slopes are irrigated when water is available. In past years, some of the oat crop has been threshed for grain. Capability unit IIe-5.

Diablo clay, 15 to 30 percent slopes (DbE).--This soil is similar to Diablo clay 9 to 15 percent slopes, but the depth to weathered rock generally is 30 to 45 inches. This soil contains less lime than Diablo clay, 9 to 15 percent slopes, and the lime is not so near the surface. Slickensides are more pronounced and are more numerous in this soil.

Included in mapping are small areas of Haire clay loam and Raynor clay.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 5 to 7 inches. Landslips are common on this soil.

This soil is used mainly for range. Capability unit IVe-5; range site 3.

Diablo clay, 15 to 30 percent slopes, eroded (DbE2).--This soil is similar to Diablo clay, 9 to 15 percent slopes. Small gullies are visible and sheet erosion is indicated by deposition at the lower end of the slopes. Depth to parent rock is 25 to 30 inches.

Included in mapping are small areas of Haire clay loam and Raynor clay.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 5 inches. The effective rooting depth is about 25 to 30 inches. This soil is subject to land slippage.

This soil is used mainly for range. Capability unit IVe-5; range site 3.

Diablo clay, 30 to 50 percent slopes (DbF).--This soil is similar to Diablo clay, 9 to 15 percent slopes, but the surface layer is not so thick and slickensides are more abundant. Depth to weathered rock is 30 to 40 inches.

Included in mapping are small areas of Haire clay loam and Raynor clay. Outcrops of basic rock and inclusions of Raynor clay are frequent on the steeper slopes.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 5 to 6 inches. Landslips are a concern to management on this soil.

This soil is used mainly for range. Capability unit VIe-5; range site 7.

Diablo clay, 30 to 50 percent slopes, eroded (DbF2).--This soil is similar to Diablo clay, 9 to 15 percent slopes, but it is eroded and the depth to weathered rock is 25 to 30 inches.

Included in mapping are areas of Raynor clay and scattered outcrops of basic rock. Other areas include places where landslides have occurred.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 5 inches. The effective rooting depth is 25 to 30 inches. This soil is subject to land slippage.

This soil is used mainly for range, though most has been overgrazed. In many places rock outcrops have reduced the plant cover on these steep slopes. Capability unit VIe-5; range site 7.

Dibble Series

The Dibble series consists of well-drained, clay loams that have a clay subsoil. They are underlain, at a depth of 30 to 60 inches, by fine-grained sandstone and brittle shale interbedded with siltstone. These soils are rolling and hilly and are on uplands. They are in the hills east of Windsor along

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Chalk Hill Road and also east and south of Healdsburg. Slopes are 2 to 50 percent. Elevation ranges from 300 to 1,400 feet. Annual rainfall is 35 to 50 inches, annual temperature is 60° to 62° F., and the frost-free season is 245 to 265 days. The vegetation is chiefly annual and perennial grasses and scattered oaks. Several areas have been invaded by medusahead, an undesirable grasses. The Dibble soils are associated with the Guenoc, Laughlin, Montara, and Spreckels soils.

In a typical profile the surface layer is light brownish-gray and pale-brown, medium acid clay loam about 16 inches thick. The subsoil is dominantly light yellowish-brown, strongly acid to neutral clay about 38 inches thick. The substratum, to a depth of about 60 inches is pale-olive and brownish-yellow, slightly acid clay loam. Mixed pale-yellow and dark-gray fragments of sandstone and siltstone occur at a depth of 60 inches.

Dibble soils are used mainly for grazing. A few areas of gently sloping Dibble soils are used for orchards, vineyards, and cropland. These soils are subject to land slippage. They are some of the most unstable soils in the county. If gullies erode through the surface layer to the subsoil, erosion is accelerated and water courses deepen rapidly.

Dibble clay loam, 2 to 9 percent slopes (DcC).--This gently sloping to moderately sloping soil is on uplands. Slopes are dominantly 5 to 9 percent.

Typical profile in a pasture in good condition; slightly convex slope of 7 percent that faces north; 1,800 feet north and 1,600 feet west of center of (section 25 T. 9 N., R. 9 W.); the profile was moist below a depth of 10 inches when examined:

A11--0 to 10 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; common very fine roots and many fine roots; many worm holes; medium acid (pH 5.8); clear, smooth boundary.

A12--10 to 16 inches, pale-brown (10YR 6/3) clay loam that has gray specks, dark grayish brown (2.5Y 4/2) moist; weak, medium, angular blocky structure; hard, firm, very sticky and plastic; a few very fine and fine roots; many worm holes; a few very thin clay films; medium acid (pH 5.8); clear, wavy boundary.

B21t--16 to 26 inches, light yellowish-brown (10YR 6/4) and strong-brown (7.5YR 6/5) clay, brownish yellow (10YR 6/6) moist; irregular black stains; weak and moderate, medium and coarse, prismatic structure; hard, very firm, sticky and very plastic; common very fine roots; common, very fine, tubular pores; a few skickensides; strongly acid (pH 5.5); clear, wavy boundary.

B22t--26 to 54 inches, light yellowish-brown (10YR 6/4) and dark-brown (10YR 3/3) clay, yellowish brown (10YR 5/8) moist; strong, coarse, angular blocky structure; hard, very firm, sticky and very plastic; common very fine roots; common, very fine, tubular pores; continuous moderately thick clay films; a few slickensides; neutral (pH 7.0); clear, wavy boundary.

C1--54 to 60 inches, mixed pale-olive (5Y 6/3) and brownish-yellow (10YR 6/6) clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, very firm, sticky and plastic; a few very fine roots; a few, fine, tubular pores; many moderately thick clay films in pores and as bridges; slightly acid (pH 6.5); clear, irregular boundary.

C2--60 inches, mixed pale-yellow and dark-gray fragments of sandstone and siltstone.

The A horizon ranges from light brownish gray and pale brown to brown in color. The B horizon ranges from 20 to 40 inches in thickness and from light yellowish brown to dark brown in color. Depth to the C2 horizon varies from about 40 to 60 inches. The C2 horizon has variable proportions of sandstone and siltstone. Some areas are primarily soft crumbly silty bedrock. Others contain mostly brittle, shattered, fine-grained sandstone mixed with gray shale and siltstone.

Included in mapping are small areas of Guenoc gravelly silt loam, Laughlin loam, Montara cobbly clay loam, and Spreckels loam.

Permeability is slow in the subsoil of this Dibble soil. Runoff is medium, and the hazard of erosion is moderate. Fertility is moderately high. The available water capacity is 6.5 to 8 inches.

This soil is used mainly for pasture. Some areas on the lower slopes have been planted to grasses and legumes and have been irrigated when water was available. Some areas have been heavily invaded by medusahead. A few orchards and vineyards have been planted. Capability unit IIIe-3; range site 1.

Dibble clay loam, 9 to 15 percent slopes (DcD).--This soil is similar to Dibble clay loam, 2 to 9 percent slopes, but the surface layer is 2 to 6 inches thinner. The subsoil is dark brown.

Included in mapping are small areas of Laughlin loam, Montara cobbly clay loam, and Spreckels loam.

Runoff is medium to rapid, and the hazard of erosion is high. The available water capacity is about 6 to 7 inches. This soil is subject to land slippage.

Uses of this Dibble soil are similar to Dibble clay loam, 2 to 9 percent slopes. Capability unit IVe-3; range site 1.

Dibble clay loam, 15 to 30 percent slopes (DcE).--This soil has a thinner subsoil than the Dibble clay loam, 2 to 9 percent slopes. It is only 22 to 30 inches deep. Also, on these steeper slopes, slickensides are more in evidence indicating that in places old landslips occurred.

Included in mapping are small areas of Guenoc gravelly silt loam, Laughlin loam, and Spreckels loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 6 to 7 inches. This soil is subject to land slippage.

Nearly all of this soil is used for grazing. Capability unit VIe-3; range site 1.

Dibble clay loam, 15 to 30 percent slopes, eroded (DcE2).--This soil is similar to Dibble clay loam, 2 to 9 percent slopes, though its surface layer is about 10 inches thick because of sheet and gully erosion that resulted from excessive cultivation and overgrazing. Slickensides are evident in the subsoil on these steeper slopes, and there is a greater amount of black staining and dark-gray mottling.

Included in mapping are small areas of Guenoc gravelly silt loam, Laughlin loam, and Spreckels loam. Also included are areas where landslides have occurred.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 5.5 to 7 inches. These soils are subject to land slippage.

This soil is used mainly for grazing. Medusahead on these eroded slopes has been a concern of management. Capability unit VIe-3; range site 1.

Dibble clay loam, 30 to 50 percent slopes (DcF).--This soil is similar to Dibble clay loam, 2 to 9 percent slopes, but the combined surface layer and subsoil is about 36 inches thick. Slickensides are very prominent in the subsoil. In some places, the surface topography shows the presence of old, fairly well-healed landslips.

Included in mapping are small areas of Laughlin loam, Montara cobbly clay loam, Spreckels loam and small areas of sandstone outcrops.

Permeability is slow in the subsoil of this Dibble soil. Runoff is rapid, and the hazard of erosion is high. The available water capacity is 5 to 7 inches. Land slippage is a hazard on this soil.

This soil is used mainly for grazing. Capability unit VIe-3; range site 5.

Dibble clay loam, 30 to 50 percent slopes, eroded (DcF2).--This soil is similar to Dibble clay loam, 2 to 9 percent slopes, but the combined surface layer and subsoil is about 30 inches thick. The surface layer is 3 to 10 inches thick. Sheet and gully erosion has occurred. Slickensides are very prominent in the subsoil. In places, there is evidence of fairly well stabilized and active landslips, and areas of this soil are subject to land slippage.

Included in mapping are small areas of Laughlin loam, Montara cobbly clay loam, and Spreckels loam. In some areas, sandstone rock fragments and rock outcrops cover up to 3 percent of the surface.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 7 inches.

Nearly all of this soil is used for grazing. Capability unit VIe-3; range site 5.

Dune Land

Dune land (DuE) consists of loose, shifting sand. It is in many areas scattered along the coast. The largest area is on the coastal side at the north end of Bodega Head extending toward the mouth of Salmon Creek. Much dune grass has been planted in an effort to control mass movement of the sand. Ocean winds have shifted the dunes. This shift has threatened agricultural land and possible homesites.

Dune land is used mainly for recreational purposes. Capability unit VIIIe-4.

Empire Series

The Empire series consists of well-drained loams that have a silty clay loam subsoil. At a depth of 30 to 60 inches the soils are underlain by weathered, soft sedimentary rocks and marine-terrace material. These soils are strongly sloping to steep and are on coastal terraces, ridgetops, and mountainous uplands. They are near the Pacific Ocean in the west-central and northwestern parts of the county. Slopes are 9 to 50 percent. Elevation ranges from 300 to 1,500 feet. Annual rainfall is 40 to 65 inches, annual temperature is 52° to 54° F., and the frost-free season is 290 to 310 days. In most places the vegetation is chiefly Douglas-fir, redwood, Bishop pine, madrone, and baywood, and there is a brushy understory. Areas that have been logged, however, are covered with grass, ferns, and small shrubs. The Empire soils are associated with the Caspar, Goldrige, Hugo, Mendocino, and Noyo soils.

In a typical profile the surface layer is grayish-brown, slightly acid loam about 11 inches thick. This layer is covered with a thin litter of deciduous leaves and of redwood and Douglas-fir needles and twigs. The subsoil is pale-brown and brown heavy loam and brown silty clay loam. It is slightly acid and is about 23 inches thick. The substratum, to a depth of 60 inches or more, is reddish-yellow and white, strongly acid and very strongly acid silty clay loam.

Empire soils are used mainly for timber. Some areas have been cleared and are used for grazing.

Empire loam, 9 to 30 percent slopes (EmE).--This soil is on ridgetops, terraces, and uplands. The relief is undulating to smooth.

Typical profile on a ridgetop; slope of 10 percent; supports redwood, Douglas-fir, and madrone; at an elevation of 1,100 feet, 2.7 miles east-northeast of Stewart's Point (sec. 6, T. 9 N., R. 13 W.); the profile was moist throughout when examined:

01--1 inch to 0, litter of deciduous leaves and redwood and Douglas-fir needles and twigs.

A11--0 to 4 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; moderate, medium and coarse, granular structure; soft, friable, nonsticky and nonplastic; many very fine and fine roots and a few coarse roots; many, very fine, tubular and interstitial pores; slightly acid (pH 6.5); clear, smooth boundary.

A12--4 to 11 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine and fine roots; many, very fine and fine, tubular pores; slightly acid (pH 6.3); clear, smooth boundary.

B1--11 to 19 inches, pale-brown (10YR 6/3) heavy loam, dark brown (10YR 4/3) moist; moderate, medium, angular blocky structure; hard, friable, nonsticky and slightly plastic; many fine and medium roots and a few coarse roots; many, very fine and fine, tubular and interstitial pores; common thin clay films in pores and on ped faces; strongly acid (pH 5.5); clear, wavy boundary.

B2t--19 to 34 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; strong, medium and coarse, angular blocky structure; very hard, firm, sticky and plastic; many medium and fine roots; a few coarse roots; common, very fine and fine, tubular pores; many moderately thick clay films in pores and on ped faces; strongly acid (pH 5.5); clear, wavy boundary.

C1--34 to 50 inches, reddish-yellow (7.5YR 6/6) silty clay loam, dark brown (7.5YR 4/4) moist; strongly weathered rock fragments give a mottled appearance of very pale brown (10YR 7/4) and yellow (10YR 7/6); massive; very hard, friable, slightly sticky and plastic; a few fine roots and common medium roots; common, very fine and fine, tubular and interstitial pores; moderately thick clay films in some pores; strongly acid (pH 5.5).

C2--50 to 60 inches, reddish-yellow (7.5YR 7/8) and white (10YR 8/2) silty clay loam, strong brown (7.5YR 5/8) and pinkish gray (7.5YR 7/2) moist; massive; very hard, friable, slightly sticky and plastic; a few medium and coarse roots; common, very fine and fine, tubular and interstitial pores; moderately thick clay films in some pores; very strongly acid (pH 5.0).

The A horizon ranges from grayish brown to brown in color and from 9 to 15 inches in thickness. This horizon is slightly acid to medium acid. The B horizon ranges from loam to silty clay loam and from brown to very pale brown.

Included in mapping are small areas of Caspar sandy loam, Hugo very gravelly loam, Mendocino sandy clay loam, and Noyo coarse sandy loam.

Permeability is moderate in the subsoil of this Empire soil. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is moderate. The available water capacity is 9 to 11 inches. The effective rooting depth is 50 to 60 inches.

This soil is used mainly for timber. Some areas that have been logged are used for limited grazing. Capability unit VIe-1; woodland group 1.

Empire loam, 30 to 50 percent slopes (EmF).--This soil is similar to Empire loam, 9 to 30 percent slopes, but it is steeper and only 40 to 50 inches deep over weathered sedimentary rock and marine-terrace material.

Included in mapping are small areas of Caspar sandy loam, Goldridge fine sandy loam, and Mendocino sandy clay loam.

The available water capacity of this Empire soil is 7 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for timber. Some areas have been used for limited grazing. Capability unit VIe-1; woodland group 2.

Empire-Caspar complex, 9 to 50 percent slopes (EpF).--This mapping unit is above the low coastal bench terraces between Fort Ross and Gualala in the northwestern part of the county. Empire soils make up about 70 percent of the complex, and Caspar soils about 30 percent.

The Empire soils have a profile similar to that of Empire loam, 9 to 30 percent slopes, but they are only 30 to 50 inches deep. Their permeability is moderately slow. Runoff is medium to rapid, and the erosion hazard is moderate to high. The available water capacity is 9 to 11 inches. Fertility is moderate.

The Caspar soils have a profile similar to that of Caspar sandy loam, 15 to 30 percent slopes, but they are only 30 to 50 inches deep. Permeability of these soils is moderate. Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 9 to 11 inches. Fertility is moderate.

These soils are used for timber. Capability unit VIe-1; woodland group 2.

Felta Series

The Felta series consists of well-drained very gravelly loams that have a very gravelly clay loam subsoil. These soils formed from material from volcanic tuffs mixed with uplifted river sediment and metamorphosed basic rock. These soils are on dissected terraces. They are in the range of hills which extend from southeast of Healdsburg to southeast of Santa Rosa, bordering the eastern side of the central Santa Rosa plains. Slopes are 5 to 75 percent. Elevation ranges from 300 to 2,000 feet. Annual rainfall is 25 to 35 inches, annual temperature is 59° to 60° F., and the frost-free season is 260 to 280 days. In most places the vegetation is chiefly black oak, white oak, shrubs, and grass. The Felta soils are associated with the Guenoc, Laniger, Spreckels, and Toomes soils.

In a typical profile the surface layer is grayish-brown, slightly acid very gravelly loam about 5 inches thick. The subsoil is grayish-brown, slightly acid very gravelly clay loam and very gravelly heavy clay loam. At a depth of about 24 inches is mixed volcanic tuff, river sediment, metamorphosed

basic rock, and grayish-brown, strongly acid, sandy clay loams.

Felta soils are used mainly for grazing. Some oak thicket areas provide firewood for home use.

Felta very gravelly loam, 5 to 15 percent slopes (FaD).--This soil is on terraces and uplands. In most places, the slope ranges between 10 and 15 percent.

Typical profile in a small thicket of live oak and white oak; slightly convex slope of 4 percent that faces south; 1 mile east of the junction of Chalk Hill Road and Pleasant Avenue (SE1/4 NW1/4 sec. 16, T. 8 N., R. 8 W.); the profile was moist throughout when examined:

A1--0 to 5 inches, grayish-brown (10YR 5/2) very gravelly loam, very dark brown (10YR 2/2) moist; moderate, very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many, very fine and fine, interstitial pores and common, fine, tubular pores; slightly acid (pH 6.5); clear, wavy boundary.

B21t--5 to 14 inches, grayish-brown (10YR 5/2) very gravelly clay loam, very dark grayish-brown (10YR 3/2) moist; moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots from grass and trees; many, fine, interstitial pores; many thin clay films in pores; slightly acid (pH 6.3); 80 to 90 percent cobblestones and gravel; clear, wavy boundary.

B22t--14 to 24 inches, grayish-brown (10YR 5/2) very gravelly heavy clay loam, very dark grayish-brown (10YR 3/2) moist; moderate, medium, subangular blocky structure; slightly hard, friable, sticky and slightly plastic; common medium roots and many very fine and fine roots; many, fine and very fine, interstitial pores and common, fine, tubular pores; many thin clay films in pores and as bridges; slightly acid (pH 6.3); 50 to 70 percent gravel; abrupt, irregular boundary.

C--24 to 60 inches, grayish-brown (10YR 5/2) and brown (10YR 5/3) very gravelly sandy clay loam, dark yellowish brown (10YR 4/4) moist; many moderately thick clay films in pores and as bridges; strongly acid (pH 5.5); about 80 to 85 percent mixed gravel of volcanic basic and rhyolitic rocks.

Varying quantities of basic and rhyolitic rock fragments and gravel are throughout the profile. These could be so numerous in the A horizon that they would interfere with cultivation. The A horizon varies from 4 to 19 inches in thickness. Depth to the very gravelly C horizon varies from 12 to 32 inches.

Included in mapping are areas of soils where the subsoil is only slightly evident or where the subsoil is 15 to 24 inches thick with a higher percentage of clay and the soils intergrade in the Spreckels series. Also included with this Felta soil are Guenoc gravelly silt loam, Laniger loam, Spreckels loam, and Toomes loam, and a few rock outcrops.

Permeability is moderate in the subsoil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is moderate. The available water capacity is 5 to 6.5 inches.

This soil is used mainly for range. A few areas are used for growing grasses and legumes. Oak trees have provided a good supply of firewood. Capability unit IVe-4; range site 4.

Felta very gravelly loam, 15 to 30 percent slopes (FaE).--This soil is similar to Felta very gravelly loam, 5 to 15 percent slopes, but it is steeper, the surface layer is 3 to 6 inches shallower, and there is 50 to 60 percent gravel by volume throughout the profile.

Included in mapping are small areas of Guenoc gravelly silt loam, Spreckels loam, and Toomes rocky loam.

Runoff is medium to rapid. The hazard of erosion is moderate to high.

This soil is used mainly for grazing. A few small prune and apple orchards have been planted. Oak trees provide firewood. Capability unit VIe-4; range site 4.

Felta very gravelly loam, 30 to 50 percent slopes (FaF).--This soil is similar to Felta very gravelly loam, 5 to 15 percent slopes, but depth to the substratum is 14 to 18 inches, and there is less clay in the subsoil on these steeper slopes. There are also 50 to 60 percent stones and gravel throughout the profile. Because of droughtiness and steepness this soil has fewer perennial grasses than other Felta soils.

Included in mapping are small areas of Laniger loam, Spreckels loam, and Toomes rocky loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 6 inches.

This soil is used mainly for range. Oak trees are used as a source of firewood. Capability unit VIe-4; range site 8; woodland group 4.

Felta very gravelly loam, 50 to 75 percent slopes (FaG).--This soil is 12 to 15 inches deep to the substratum. This very steep soil is very droughty and has more stones and gravel, by volume, throughout the profile than Felta very gravelly loam, 5 to 15 percent. The cover is mainly scrubby white oak and black oak. There is some manzanita and very little grass.

Included in mapping are small areas of Spreckels loam and Toomes rocky loam.

Runoff is very rapid and the hazard of erosion is very high. The available water capacity is 3 to 4 inches.

This soil is used mainly for wildlife, such as deer, and for watershed. Some places are used for limited grazing. Capability unit VIIe-4; range site 8.

Forward Series

The Forward series consists of well-drained, gravelly loams that have a gravelly sandy clay loam subsoil. At a depth of 20 to 40 inches these soils are underlain by rhyolite rock and soft rhyolitic tuff. These soils are on mountainous uplands. They are mainly in the hilly areas along the eastern parts of the county from Mt. St. Helena southward to the vicinity of the town of Sonoma. Slopes are 9 to 75 percent. Elevation ranges from 800 to 4,000 feet. Annual rainfall is 30 to 60 inches, annual temperature is 48° to 54° F., and the frost-free season is 225 to 250 days. In most places the vegetation is chiefly hardwoods and shrubs, but there are a few areas that have scattered patches of Douglas-fir and redwood. The Forward soils are associated with the Kidd, Laniger, and Toomes soils.

In a typical profile the surface layer is about 6 inches of gray, neutral gravelly loam and about 4 inches of light-gray, very strongly acid gravelly clay loam. The subsoil is white, medium acid gravelly sandy clay loam, about 11 inches thick. At a depth of about 21 inches is weathered rhyolite.

Forward soils are used mainly for range. A few timbered areas have been cleared.

Forward gravelly loam, 9 to 30 percent slopes (FoE).--This rolling soil is on uplands. In most places the slope ranges from 20 to 30 percent.

Typical profile 3 miles east-northeast of Geyserville (SW1/4 NE1/4 sec. 16, T. 10 N., R. 9 W.):

A1--0 to 6 inches, gray (10YR 6/1) gravelly loam, dark brown (10YR 3/3) moist; moderate, fine, subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common very fine, fine, and medium roots; neutral (pH 7.0); clear, wavy boundary.

A3--6 to 10 inches, light-gray (10YR 7/1) gravelly clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; a few medium roots and common fine roots; very strongly acid (pH 5.0); clear, irregular boundary.

B2--10 to 21 inches, white (2.5Y 8/2) gravelly sandy clay loam, pale brown (10YR 6/3) moist; massive; hard, friable, slightly sticky and slightly plastic; a few fine and medium roots; many moderately thick clay films as bridges; medium acid (pH 6.0); gradual, irregular boundary.

R--21 inches, weathered rhyolite; root penetration along fracture planes.

The A1 horizon ranges from gravelly loam to gravelly sandy loam in texture and from grayish brown to pale brown or from gray to light gray in color. The B horizon ranges from gray to white in color. The depth to bedrock is about 20 to 40 inches.

Small areas of Kidd gravelly loam, Laniger loam, Toomes loam and Rock land are included.

Permeability is moderate in the subsoil of this Forward soil. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is low. The available water capacity is 3 to 5 inches.

Some areas of this soil have been cleared for grazing. Areas where there were a few scattered Douglas-fir and redwood trees have been logged. Capability unit VIe-8; range site 4; woodland group 1.

Forward gravelly loam, 30 to 75 percent slopes (FoG).--This soil is similar to Forward gravelly loam, 9 to 30 percent slopes, but it is deeper. The depth to bedrock ranges from 25 to 30 inches.

Included in mapping are small areas of Kidd stony loam, Laniger loam, and Toomes loam. Also included are some areas of rhyolite rock outcrops.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is 3 to 4 inches. The effective rooting depth is 20 to 30 inches.

Nearly all areas of this soil have been left in their natural state with the exception of limited logging of Douglas-fir and redwood trees. Grazing is limited. Capability unit VIIe-8; range site 8; woodland group 9.

Forward-Kidd complex, 30 to 75 percent slopes (FrG).--This mapping unit is on the east side of the Sonoma Valley near the Sonoma-Napa County line and northeast of Santa Rosa, in the vicinity of Mt. St. Helena, and in the north along the Sonoma-Lake County line. Forward and Kidd soils each make up about 45 percent of the complex. The remaining 10 percent is made up of Toomes soils and Rock land.

The Forward soils have a profile similar to that of Forward gravelly loam, 9 to 30 percent slopes, but they are 20 to 25 inches deep. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is 2.5 to 3 inches.

The Kidd soils have a profile similar to Kidd gravelly loam, 9 to 50 percent slopes, but depth to bedrock is 5 to 15 inches. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is 1 to 2 inches.

These soils are used mainly for range, as wildlife habitat, recreation, and watershed. Capability unit VIIe-8; Forward, range site 8; Kidd, range site 10.

Goldridge Series

The Goldridge series consists of moderately well-drained fine sandy loams that have a sandy clay loam subsoil. At a depth of 40 to more than 60 inches the soils are underlain by coarse-grained, weakly consolidated sandstone. These soils are on uplands. They occur along the coast from the Freestone-Sebastopol area north to the vicinity of Annapolis. Slopes are 2 to 50 percent. Elevation ranges from

500 to 2,000 feet. Annual rainfall is 30 to 45 inches, annual temperature is 52° to 56° F., and the frost-free season is 220 to 240 days. In most places the vegetation is chiefly redwood, Douglas-fir, baywood, oaks and some small shrubs and grasses. Much of the area of these soils in the southern part of the county has been cleared and is used for orchards. The Goldridge soils are associated with the Blucher, Cotati, Sebastopol, and Steinbeck soils.

In a typical profile the surface layer is light brownish-gray, very strongly acid and strongly acid fine sandy loam about 24 inches thick. The subsoil is light-gray, pale-yellow, and mottled very pale-brown and light yellowish-brown, very strongly acid fine sandy loam and sandy clay loam. The substratum, to a depth of 72 inches, is very pale-brown very strongly acid sandy clay loam.

Goldridge soils are used mainly for apple orchards and for timber. Scattered grassy areas are used for range and pasture.

Goldridge fine sandy loam, 2 to 9 percent slopes (GdC).--This soil is on terraces. In most places slopes range from 4 to 7 percent.

Typical profile in the northwest corner (NW1/4 SW1/4 sec. 11, T. 6 N., R. 9 W.):

Ap--0 to 7 inches, light brownish-gray (10YR 6/2) fine sandy loam, yellowish brown (10YR 5/4) moist; moderate, very fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; common, very fine and fine, tubular and interstitial pores; very strongly acid (pH 5.0); clear, wavy boundary.

A1--7 to 20 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, friable, nonsticky and nonplastic; many very fine and fine roots and a few medium and coarse roots; many, fine and very fine, interstitial and tubular pores; strongly acid (pH 5.2); clear, wavy boundary.

A3--20 to 24 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, yellowish brown (10YR 5/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; common very fine and fine roots; many, fine and very fine, tubular and interstitial pores; a few thin clay films in pores; strongly acid (pH 5.1); clear, wavy boundary.

B1t--24 to 28 inches, light-gray (10YR 7/2) fine sandy loam, yellowish brown (10YR 5/6) moist; massive; slightly hard, firm, slightly sticky and slightly plastic; many very fine and fine roots; many, fine and very fine, interstitial and tubular pores; many thin clay films in pores; very strongly acid (pH 5.0); clear, wavy boundary.

B21t--28 to 41 inches, pale-yellow (2.5Y 7/4) sandy clay loam that has common, fine, distinct olive-yellow mottles; when moist, yellowish brown (10YR 5/6) and having common, fine, distinct brown mottles; massive; very hard, firm, sticky and plastic; common fine roots and a few medium roots; many, fine and very fine, tubular pores; continuous, thick clay films in pores; very strongly acid (pH 4.6); gradual, irregular boundary.

B22t--41 to 57 inches, mottled, very pale brown (10YR 7/4) and light yellowish-brown (10YR 6/4) sandy clay loam; when moist, olive yellow (2.5Y 6/6) and having common, light-gray streaks; massive; very hard, firm, slightly sticky and slightly plastic; a few fine roots; common, fine and very fine, tubular pores; continuous thick clay films in pores; very strongly acid (pH 4.5); diffuse, wavy boundary.

Cg--57 to 72 inches, very pale brown (10YR 8/4) sandy clay loam that has common, fine, distinct brownish-yellow mottles; when moist, yellow (2.5Y 7/6) and having common, large, gray mottles; massive; slightly hard, firm, nonsticky and slightly plastic; common, very fine and fine, tubular pores; continuous thick clay films in pores; very strongly acid (pH 4.5); diffuse, wavy boundary.

The A horizon ranges from light brownish gray and light yellowish brown to yellowish brown in color and from fine sandy loam to loamy sand in texture. The structure is moderate granular or the soil is massive. The reaction ranges from slightly acid to very strongly acid. This horizon ranges in thickness from 20 to 30 inches. The Bt horizon ranges from light gray or pale brown to very pale brown or reddish yellow to pale yellow or yellowish brown in color. Yellowish-brown or olive-yellow to brown mottles are common. Texture ranges from fine sandy loam to silty clay loam, but it is typically sandy clay loam. This horizon is slightly hard to very hard. The reaction is strongly acid to very strongly acid.

Included in mapping are small areas of Blucher loam and Blucher clay loam, Cotati fine sandy loam, Sebastopol sandy loam, and Steinbeck loam.

Permeability is moderately slow in the subsoil of this Goldridge soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is moderate. The available water capacity is 9 to 11 inches. Seep areas are in swales and on footslopes in places on this soil.

This soil is used mainly for timber production. In the areas 5 to 6 miles from Sebastopol, nearly all of this soil has been cleared and is used for apple orchards. In the areas near Cazadero northwest of Annapolis, much of this soil has been cleared and is now used for pasture. Capability unit IIIe-1; woodland group 4.

Goldridge fine sandy loam, 9 to 15 percent slopes (GdD).--This soil is similar to Goldridge fine sandy loam, 2 to 9 percent slopes.

Included in mapping are small areas of Blucher loam, Cotati fine sandy loam, and Sebastopol sandy loam.

Runoff is medium, and the hazard of erosion is moderate.

The main use of this soil where it is adjacent to Sebastopol soils is for apple orchards. Other inland areas between Cazadero and Annapolis have been cleared and are used for grazing. Still other areas are used for timber production. Capability unit IVe-1; woodland group 4.

Goldridge fine sandy loam, 9 to 15 percent slopes (GdD2).--This soil is similar to Goldridge fine sandy loam, 2 to 9 percent slopes, but the surface layer is less than 20 inches thick as a result of erosion.

Included in mapping are small areas of Cotati fine sandy loam, Sebastopol sandy loam, and Steinbeck loam.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 8 to 10 inches.

The main use of the soil is for apple orchards. Other areas are used for timber production. Capability unit IVe-1; woodland group 4.

Goldridge fine sandy loam, 15 to 30 percent slopes (GdE).--This soil is similar to Goldridge fine sandy loam, 2 to 9 percent slopes, but the surface layer is less than 16 inches thick. Slopes are moderately steep.

Included in mapping are small areas of Cotati fine sandy loam, Sebastopol sandy loam, and Steinbeck loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 8 to 10 inches.

This soil is used mainly for timber and apple orchards. Inland areas between Cazadero and Annapolis have been cleared and are used for grazing. Capability unit VIe-1; woodland group 4.

Goldridge fine sandy loam, 15 to 30 percent slopes, eroded (GdE2).--This soil is similar to Goldridge fine sandy loam, 2 to 9 percent slopes, but there is moderate erosion. Soil depth to the substratum varies from 15 to 36 inches as a result of past erosion. Soft, weathered sandstone occurs at depths from 40 to more than 60 inches. Slopes are moderately steep.

Included in mapping are small areas of Cotati fine sandy loam, Sebastopol sandy loam, and Steinbeck loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 7 to 9 inches.

This soil is used mainly as woodland. Areas adjacent to Sebastopol soils are used for apple orchards. Other areas inland from the coast between Cazadero and Annapolis, have been cleared and are used to grow grass. Capability unit VIe-1; woodland group 4.

Goldridge fine sandy loam, 30 to 50 percent slopes (GdF).--This soil is similar to Goldridge fine sandy loam, 2 to 9 percent slopes, but it is steep and occupies side hills. Soft sandstone occurs at a depth of 40 to more than 60 inches.

Included in mapping are small areas of Sebastopol sandy loam and Steinbeck loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 7 to 9 inches.

This soil is used mainly for Douglas-fir timber. Capability unit VIe-1; woodland group 5.

Goldridge fine sandy loam, 30 to 50 percent slopes, eroded (GdF2).--This soil is similar to Goldridge fine sandy loam, 2 to 9 percent slopes, but the surface layer is 10 to 20 inches thick because of moderate erosion. Sandstone occurs at depths of 40 to 50 inches. Accelerated erosion and occasional gullying have occurred in most places.

Included in mapping are small areas of Sebastopol sandy loam and Steinbeck loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 6 to 8 inches.

The main use of this soil is for timber production, chiefly Douglas-fir and redwood. Capability unit VIe-1; woodland group 5.

Goulding Series

The Goulding series consists of well-drained clay loams. These soils are underlain at a depth of 12 to 24 inches by metamorphosed basic igneous and weathered andesitic basalt of old volcanic formations. These soils are on mountainous uplands. They are mainly in the hilly, eastern third of the county from the Mark West Springs area southward to the vicinity of the town of Sonoma. Slopes are 5 to 75 percent. Elevation ranges from 500 to 2,500 feet. Annual rainfall is 30 to 50 inches, annual temperature is 54° to 56° F., and the frost-free season is 220 to 240 days. In most places the vegetation is chiefly annual and perennial grasses with scattered clumps of oak trees, manzanita, and small shrubs. The Goulding soils are associated with the Boomer, Henneke, Spreckels, and Toomes soils.

In a typical profile the surface layer is brown and dark-brown, slightly acid and medium acid clay loam about 11 inches thick. The subsoil is dark-brown, slightly acid very gravelly clay loam about 11 inches thick. Fractured basalt occurs at a depth of about 22 inches.

Goulding soils are used mainly for grazing by sheep and cattle. A few lower slope areas are used for such crops as cultivated oat and vetch hay or for dryland pasture.

Goulding clay loam, 5 to 15 percent slopes (GgD).--This moderately sloping to strongly sloping soil is on ridgetops and on low rolling hills. Most of the slopes are smooth.

Typical profile in a southeast-facing pasture in good range condition, 300 feet north of Guenza Road and about 3,000 feet west of Grange Road (SE1/4 NE1/4 sec. 8, T. 6 N., R. 7 W.); the profile was slightly moist when examined:

A11--0 to 2 inches, brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; strong, fine, granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots; slightly acid (pH 6.5); abrupt, smooth boundary.

A12--2 to 11 inches, dark-brown (10YR 3/3) clay loam, very dark brown (10YR 2/2) moist; moderate, fine and medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine pores and common, very fine, tubular pores; medium acid (pH 6.0); profuse worm activity; clear, wavy boundary.

B2--11 to 22 inches, dark-brown (7.5YR 3/2) very gravelly clay loam, dark reddish brown (5YR 2/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many, fine and very fine, interstitial pores and common, fine, tubular pores; a few thin clay films in pores; slightly acid (pH 6.2); clear, irregular boundary.

R--22 inches, highly fractured rock separated by reddish-brown (5YR 4/4) soil material that has yellowish-red (5YR 5/6) common, medium, distinct mottles; dark reddish brown (5YR 3/4) moist; slightly hard, sticky and plastic; a few very fine roots; common moderately thick clay films on rock faces; slightly acid (pH 6/2); highly fractured vesicular basalt that breaks to angular fragments throughout horizon, about 95 percent by volume.

The A horizon ranges in color from brown to reddish brown and contains as much as 15 percent coarse fragments, such as gravel, cobblestones, and stones. Depth to shattered bedrock ranges from 20 to 24 inches.

Included in mapping are small areas of Boomer loam, Henneke gravelly loam, Spreckels loam, and Toomes loam. There are also scattered areas of basaltic rock outcrop, as well as areas consisting of 24 to 36 inches of soil over rock.

Permeability in the subsoil is moderate. Runoff is medium, and the hazard of erosion is moderate. Fertility is low. The available water capacity is approximately 3.5 to 4.5 inches.

This soil is used mainly for grazing, but some fields on the lower slopes have been planted with oats and vetch for hay. A few areas are irrigated where adequate water is available. Much of this soil has been cleared of the oak and brush to increase grazing acreage and to supply firewood. Capability unit IIIe-1; range site 1.

<u>Goulding clay loam, 15 to 30 percent slopes</u> (GgE).--This soil is similar to Goulding clay loam, 5 to 15 percent slopes.

Included in mapping are small areas of Boomer loam, Spreckels loam, Toomes loam, and a few areas of rock outcrops.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

The main use of this soil is for grazing. Other uses are similar to those of Goulding clay loam, 5 to 15 percent slopes. Capability unit IVe-1; range site 1.

<u>Goulding clay loam, 30 to 50 percent slopes</u> (GgF).--This soil is slightly shallower to shattered rock than Goulding clay loam, 5 to 15 percent slopes. The average soil depth is 16 to 20 inches.

Included in mapping are small areas of Henneke gravelly loam, Spreckels loam, Toomes loam, and a few areas of rock outcrops.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 3 to 3.5 inches.

The main use of this soil is for grazing, where it has been cleared. The cleared areas have also provided firewood. Capability unit VIe-1; range site 1.

<u>Goulding clay loam, 30 to 50 percent slopes, eroded</u> (GgF2).--This soil is shallower than Goulding clay loam, 5 to 15 percent slopes. Because of erosion this Goulding soil has an effective rooting depth of 14 to 20 inches.

Included in mapping are small areas of Henneke gravelly loam, Spreckels loam, and Toomes loam. Outcrops of basaltic rock are scattered throughout areas of this soil.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 2.5 to 3.5 inches.

This soil is used mainly for range. Capability unit VIe-1; range site 1.

<u>Goulding clay loam, 50 to 75 percent slopes</u> (GgG).--This soil is somewhat shallower than Goulding clay loam, 5 to 15 percent slopes. Depth to bedrock ranges from 16 to 20 inches.

Included in mapping are small areas of Boomer loam, Spreckels loam, and Toomes loam. Outcrops of basaltic rock are scattered throughout areas of this soil.

Runoff is very rapid, and the hazard of erosion is very high. The available water capacity is 3 to 3.5 inches.

This soil is used mainly for range. Capability unit VIIe-1; range site 5.

<u>Goulding cobbly clay loam, 5 to 15 percent slopes</u> (GlD).--This soil is shallower and contains more cobblestones than Goulding clay loam, 5 to 15 percent slopes. The surface layer contains as much as 20 percent cobblestones and stones, by volume, and ranges from 16 to 24 inches deep. Also, the parent rock under this soil is harder.

Included in mapping are small areas of Henneke gravelly loam, Spreckels loam, Toomes loam, and a few rock outcrops.

Available water capacity is 3 to 4.5 inches.

The use of this soil is similar to that of Goulding clay loam, 5 to 15 percent slopes. A few family-owned vineyards and orchards have been planted, but most of this soil is used for grazing. In some places, there are excavations 10 to 15 feet deep. These resulted from the digging of cobblestones for use in building the streets of San Francisco. Also, many miles of stone fences were built around fields now used for grazing. Capability unit IVe-8; range site 4.

Goulding cobbly clay loam, 15 to 30 percent slopes (GlE).--This soil contains more cobblestones and is shallower than Goulding clay loam, 5 to 15 percent slopes. The surface layer contains as much as 25 percent cobblestones and stones and ranges in depth from 16 to 20 inches. The parent rock under this soil is harder.

Included in mapping are small areas of Boomer loam, Spreckels loam, and Toomes loam. Also, outcrops of basaltic rock are scattered throughout areas of this soil.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 3 to 3.5 inches.

This soil is used mainly for range. Capability unit VIe-8; range site 4.

Goulding cobbly clay loam, 30 to 50 percent slopes (GlF).--This soil is shallower than Goulding clay loam, 5 to 15 percent slopes. Depth ranges from 16 to 20 inches. The surface layer contains about 25 percent cobblestones and stones, by volume. The parent rock under this soil is harder.

Included in mapping are small areas of Boomer loam, Henneke gravelly loam, and Toomes rocky loam. Outcrops of basaltic rock are scattered throughout areas of this soil.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is about 3 to 3.5 inches.

This soil is used mainly for range. Capability unit VIIe-8; range site 8.

Goulding cobbly clay loam, 30 to 50 percent slopes, eroded (GlF2).--This soil is similar to Goulding clay loam, 5 to 15 percent slopes but is shallower and contains 10 to 25 percent cobblestones and stones in the surface layer. It is seldom more than 12 to 18 inches deep because of soil erosion. Also, the parent rock under this soil is harder.

Included in mapping are small areas of Boomer loam, Henneke gravelly loam, and Toomes rocky loam. Outcrops of basaltic rock are scattered throughout areas of this soil.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is about 2.5 to 3 inches.

This soil is used mainly for range. Capability unit VIIe-8; range site 8.

Goulding cobbly clay loam, 50 to 75 percent slopes (GlG).--This soil contains more cobblestones and is shallower than Goulding loam, 5 to 15 percent slopes. Also, the parent material of this soil is harder. Depth of this Goulding soil ranges from 12 to 18 inches. The surface layer contains 10 to 25 percent cobblestones and stones by volume.

Included in mapping are small areas of Henneke gravelly loam and Toomes loam. Outcrops of basaltic rock are scattered throughout areas of this soil.

Runoff is very rapid, and the hazard of erosion is very high. The available water capacity is about 2.5 to 3 inches.

This soil is used for range. Capability unit VIIe-8; range site 8.

Goulding-Toomes complex, 9 to 50 percent slopes (GoF).--This complex is in the southeastern portion of the county and in the hills southeast of Santa Rosa over the Santa Rosa Mountains to north of Sears Point. Goulding soils make up about 45 percent of this complex and Toomes soils, about 45 percent; the remaining 10 percent is Rock land.

The Goulding soils have a profile similar to that of Goulding clay loam, 5 to 15 percent slopes, but are 16 to 24 inches deep to rock. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

The Toomes soils resemble Toomes rocky loam, 2 to 30 percent slopes. Depth to rock is 5 to 20 inches. Surface runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used mainly for range. Capability unit VIIe-8; Goulding, range site 1; Toomes, range site 9.

Guenoc Series

The Guenoc series consists of well-drained gravelly silt loams that have a clay subsoil. At a depth of 20 to 40 inches the soils are underlain by andesitic basalt. These soils are on mountainous uplands. They are in the central part of the county east and north of Santa Rosa, and from the east side of the Russian River near Geyserville to south of the Alexander Valley in the foothills. Slopes are 5 to 75 percent. Elevation ranges from 400 to 1,000 feet. Annual rainfall is 30 to 50 inches, annual temperature is 58° to 60° F., and the frost-free season is 260 to 280 days. In most places the vegetation is chiefly grass, oak, and brush. The Guenoc soils are associated with the Boomer, Goulding, Spreckels, and Supan soils.

In a typical profile the surface layer is a weak-red, neutral gravelly silt loam and heavy loam about 17 inches thick. The subsoil is weak-red, slightly acid clay loam and clay. At a depth of about 38 inches is basalt mixed with medium acid red clay.

Guenoc soils are used for range and grazing. A few small areas are used for seeded dryland pasture.

Guenoc gravelly silt loam, 5 to 30 percent slopes (GrE).--This soil is on broad ridgetops or rolling hills. Most of the slopes are long.

Typical profile on a southeast-facing hill; slope of 5 percent; 8.5 miles north-northwest of Healdsburg (NE1/4 SW1/4 sec. 7, T. 10 N., R. 9 W.); the profile was moist below a depth of 14 inches when examined:

A11--0 to 4 inches, weak-red (10YR 4/2) gravelly silt loam, dusky red (10R 3/3) moist; strong, fine, angular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine, fine, medium, and coarse roots; many, very fine and fine, tubular and interstitial pores; neutral (pH 7.0); clear, smooth boundary.

A12--4 to 17 inches, weak-red (10R 4/3) heavy loam, dusky red (10R 3/3) moist; strong, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many fine, medium, and coarse roots; many, very fine, tubular pores; many thin clay films in pores and as bridges; neutral (pH 6.8); approximately 5 percent stones by volume; clear, wavy boundary.

B1--17 to 26 inches, weak-red (10R 4/3) clay loam, dusky red (10R 3/3) moist; strong, fine and medium, subangular blocky structure; hard, friable, sticky and plastic; common medium and coarse roots; many, fine and very fine, tubular pores; many thin clay films in pores and as bridges; slightly acid (pH 6.5); approximately 5 percent stones by volume; clear, wavy boundary.

B2t--26 to 38 inches, weak-red (10R 4/4) clay, dark reddish brown (2.5YR 3/4) moist; strong, coarse, subangular blocky structure; extremely hard, very firm, very sticky, very plastic; many medium roots; a few, fine, tubular pores and common, very fine, tubular pores; continuous moderately thick clay films on ped faces, in pores, and as bridges; slightly acid (pH 6.5); strongly weathered rock fragments; clear, wavy boundary.

R--38 inches, highly weathered basalt mixed with red (2.5YR 4/6) clay, dark reddish brown (2.5YR 3/4) moist; continuous thick clay films; medium acid (pH 6.0).

The A horizon ranges from red or weak red to dark reddish brown in color, and in texture from loam to silty clay loam with varying amounts of gravel. The B2 horizon varies from reddish brown to red or weak red in color and from heavy clay loam to clay in texture. Reaction generally is more acid as depth increases and ranges from neutral to medium acid. Depth to weathered basalt varies from 20 to 40 inches, sometimes within short distances.

Included in mapping are small areas of Goulding clay loam, Boomer loam, Spreckels loam, Supan silt loam, and rock outcrops.

Permeability is moderately slow in the subsoil of this Guenoc soil. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is moderate. The available water capacity is 4 to 8 inches.

This soil is used mainly for grazing. Capability unit VIe-1; range site 1.

Guenoc gravelly silt loam, 30 to 75 percent slopes (GrG).--This soil is similar to Guenoc gravelly silt loam, 5 to 30 percent slopes, but it is steeper and is only 20 to 30 inches deep.

Included in mapping are small areas of Boomer loam, Goulding cobbly clay loam, Spreckels loam, and rock outcrops or stony areas.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is 4 to 6 inches.

The main use of this soil is for grazing. Capability unit VIIe-1; range site 5.

Gullied Land

Gullied land (GuF) consists of gently sloping to steep, rounded hills that have been severely damaged by gullying. The largest acreage of Gullied land lies east of Petaluma between Penngrove and Lakeville. Smaller areas are in other parts of the county along streams and drainageways.

Gullying has occurred in places where excess runoff has cut into natural water courses on hillsides. Overgrazing by livestock has thinned or destroyed plant cover, and this has resulted in increased runoff and in aggrevated headcutting of the gullies. In areas where overlying soil material has been eroded away, the parent material of soft coastal sandstone is exposed and is subject to severe erosion.

Gullied land provides drainageways for water that flows from nearby hills during rainy periods. Capability unit VIIIe-1.

Haire Series

The Haire series consists of moderately well-drained clay loams that have a clay subsoil, and are underlain by old terrace-alluvium from mixed sedimentary and basic rock sources. These soils are on terraces and rolling hills. They are mainly in the southeastern part of the county near the town of Sonoma and in scattered areas east and southeast of Healdsburg. Slopes are 0 to 30 percent. Elevation ranges from 100 to 800 feet. Annual rainfall is 25 to 45 inches, annual temperature is 58° to 60° F., and the frost-free season is 250 to 275 days. In most places the vegetation is chiefly annual and perennial grasses and scattered oaks, but some areas have a cover of pasture or hay. The Haire soils are associated with the Arbuckle, Clear Lake, Diablo, and Zamora soils.

In a typical profile the surface layer is grayish-brown, neutral and slightly acid clay loam about 24 inches thick. The subsoil is pale-brown, strongly acid clay about 12 inches thick. The substratum, to a depth of 60 inches or more, is pale-yellow and pale-brown, strongly acid very gravelly and cobbly clay loam.

Haire soils are used mainly for dryland pasture, sheep, and cattle. A few limited areas near Healdsburg are used for vineyards.

Haire clay loam, 0 to 9 percent slopes (HcC).--This soil is on rolling terraces. Most of the slopes are smooth. In most places slopes range from 5 to 9 percent.

Typical profile in a pasture in fair condition; slightly convex northwest-facing slope of 7 percent; along a waterline leading to a water trough, 200 yards from Ramal Road in Sonoma Valley at the Wes Haire Ranch (NW1/4 NE1/4 sec. 2, T. 4 N., R. 5 W.); the profile was moist below 12 inches when examined:

Ap--0 to 7 inches, grayish-brown (10YR 5/2) clay loam that has common, fine, distinct brown mottles; very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, nonsticky and plastic; many very fine roots; many, very fine, tubular pores; neutral (pH 7.0); clear, smooth boundary.

A1--7 to 12 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish-brown (10YR 3/2) moist; massive; slightly hard, friable, slightly sticky and plastic; common fine roots; many very fine pores and common, fine, tubular pores; a few thin clay films in pores; slightly acid (pH 6.5); clear, smooth boundary.

A3--12 to 24 inches, grayish-brown (10YR 5/2) clay loam; when moist, very dark grayish brown (10YR 3/2) and having common, fine, distinct dark reddish-brown mottles; massive; slightly hard, friable, sticky and plastic; a few very fine roots; many very fine and fine pores and a few, medium, tubular pores; a few thin clay films in pores; common worm casts; slightly acid (pH 6.5); abrupt, wavy boundary.

B2t--24 to 36 inches, pale-brown (10YR 6/3) clay, dark grayish-brown (2.5Y 4/2) moist; weak, medium, columnar structure, lower part is massive; thin, discontinuous, bleached capping on columns; extremely hard, very firm, sticky and very plastic; a few very fine roots; common, very fine, tubular pores; continuous thick clay films as bridges; upper 2 or 3 inches of peds have black colloidal stains on faces; strongly acid (pH 5.5); gradual, wavy boundary.

IIC--36 to 60 inches, pale-yellow (5Y 7/3) and pale-brown (10YR 6/3) very gravelly and cobbly clay loam; when moist, variegated dark brown (10YR 3/3) and olive brown (2.5Y 4/4) massive; sticky and plastic; a few fine roots; strongly acid (pH 5.2).

Depth to the unconsolidated IIC horizon varies from 30 to 60 inches. The A horizon textures vary from light clay loam to clay loam.

Included in mapping are small areas of Arbuckle gravelly sandy loam and Arbuckle gravelly loam, Clear Lake clay, Diablo clay, and Zamora silty clay loam.

Permeability is slow in the subsoil of this Haire soil. Runoff is slow to medium and the hazard of erosion is slight to moderate. Fertility is moderate. The available water capacity is 6 to 8 inches.

This soil is used mainly for dryland pasture. Where water is available, irrigated pasture is grown. There are some vineyards in the Healdsburg area. Capability unit IIIe-3; range site 2.

Haire clay loam, 9 to 15 percent slopes (HcD).--This soil is similar to Haire clay loam, 0 to 9 percent slopes, but it is 30 to 48 inches deep to the unconsolidated substratum.

Included in mapping are small areas of Arbuckle gravelly loam and Diablo clay.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is about 6 to 8 inches.

This soil is used mainly for dryland pasture and range. Some fields near Healdsburg, in a higher rainfall belt, have been used for vineyards. Where water is available, pastures are irrigated. Capability unit IVe-3; range site 2.

Haire clay loam, 9 to 15 percent slopes, eroded (HcD2).--This soil is similar to Haire clay loam, 0 to 9 percent slopes, but it is steeper. The surface layer has been subjected to soil blowing. The average depth to the unconsolidated substratum is 24 to 26 inches.

Included in mapping are small areas of Arbuckle gravelly loam and Diablo clay.

Runoff is medium and the hazard of erosion is moderate. The available water capacity is 6 to 8 inches.

The main use of this soil is similar to Haire clay loam, 0 to 9 percent slopes. Capability unit IVe-3; range site 2.

Haire clay loam, 15 to 30 percent slopes (HcE).--This soil is similar to Haire clay loam, 0 to 9 percent slopes, but it is steeper and in only about 24 to 30 inches deep to the unconsolidated substratum. The surface layer is generally 12 and 16 inches thick over the clay subsoil.

Included in mapping are small areas of Diablo clay.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 6 to 8 inches.

This soil is used mainly for range. Capability unit VIe-3; range site 2.

Haire clay loam, 15 to 30 percent slopes, eroded (HcE2).--This soil is similar to Haire clay loam, 0 to 9 percent slopes, but it is eroded. The surface layer is 10 to 14 inches thick over the clay subsoil. In some places the clay subsoil is exposed.

Included in mapping are small areas of Diablo clay.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 5 to 7 inches.

This soil is used mainly for range. Capability unit VIe-3; range site 2.

Haire fine sandy loam, hummocky, 0 to 5 percent slopes (HaB).--This soil is similar to Haire clay loam, 0 to 9 percent slopes. Nearly all of this soil in the vicinity of Cotati, is gently sloping. Typically, it is undulating or hummocky and has a fine sandy loam surface layer. The clay subsoil is medium acid.

Included in mapping are small areas of Clear Lake clay and Zamora silty clay loam.

Fertility is low. The available water capacity is 6 to 8 inches.

In past years, much of this soil was used for chicken ranches. Now the small ranches have been subdivided and sold for homesites. Small areas, consisting of 5 to 10 acres, are fenced in for pasture for a few horses, sheep, or a few dairy cows. Capability unit IIIe-3.

Haire gravelly loam, 0 to 9 percent slopes (HbC).--This soil is similar to Haire clay loam, 0 to 9 percent slopes, but the surface layer is gravelly loam and contains 15 to 20 percent gravel. Generally, this does not interfere with productivity or cultivation.

Included in mapping are small areas of Arbuckle gravelly sandy loam, Clear Lake clay, and Diablo clay.

Fertility is moderate. The available water capacity is 5 to 7 inches.

This soil is used mainly for dryland pasture. Capability unit IIIe-3; range site 2.

Haire gravelly loam, 9 to 15 percent slopes (HbD).--This soil is similar to Haire clay loam, 0 to 9 percent slopes but it is only about 30 to 48 inches deep to the unconsolidated substratum. Gravel content ranges from 15 to 25 percent throughout the profile.

Included in mapping are small areas of Arbuckle gravelly loam and Diablo clay.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is about 5 to 7 inches.

Nearly all of this soil is used for range or pasture. Capability unit IVe-3; range site 2.

Haire gravelly loam, 9 to 15 percent slopes, eroded (HbD2).--This soil is similar to Haire clay loam, 0 to 9 percent slopes, but it is steeper, the surface layer is eroded, and the soil is only 20 to 36 inches deep over the substratum. Gravel content ranges up to 20 percent throughout the profile.

Included in mapping are small areas of Arbuckle gravelly loam and Diablo clay.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is about 5 to 7 inches.

This soil is used mainly for pasture. Capability unit IVe-3; range site 2.

Haire gravelly loam, 15 to 30 percent slopes (HbE).--This soil is similar to Haire clay loam, 0 to 9 percent slopes, but is shallower and is only 20 to 30 inches deep to the unconsolidated substratum. Content of gravel ranges up to 20 percent throughout the profile. Generally, the surface layer is 12 to 16 inches thick above the gravelly clay subsoil.

Included in mapping are small areas of Diablo clay.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is moderate. The available water capacity is about 5 to 7 inches.

This soil is used mainly for range. Capability unit VIe-3; range site 2.

Hely Series

The Hely series consists of well-drained silt loams. The soils are underlain, at a depth of 20 to 50 inches, by fine-grained sandstone and siltstone. These soils are on mountainous uplands. They are in the west and northwestern parts of the county between Occidental and the Cazadero. Slopes are 30 to 75 percent. Elevation ranges from 800 to 2,000 feet. Annual rainfall is 30 to 50 inches, annual temperature is 52° to 56° F., and the frost-free season is about 240 to 260 days. In most places the vegetation is chiefly Douglas-fir, redwood, tanoak, and laurel. The Hely soils are associated with the Hugo, Josephine, Kneeland, and Laughlin soils.

In a typical profile the surface layer is brown, medium acid silt loam about 8 inches thick. The subsoil is brown and light yellowish-brown, medium acid and strongly acid silt loam. At a depth of about 29 inches is weathered, fine-grained sandstone and siltstone.

Hely soils are used mainly for commercial timber production. A few areas have been cleared and are used for grazing.

Hely silt loam, 30 to 50 percent slopes (HeF).--This steep soil is on mountainous uplands.

Typical profile in a stand of redwood and Douglas-fir; west-facing undulating slope of 40 percent; 3.5 miles south of Monte Rio (NE1/4 NW1/4 sec. 31, T. 7 N., R. 10 W.):

A1--0 to 8 inches, brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; strong, fine, subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; a few fine roots; a few, fine, tubular pores; medium acid (pH 6.0); gradual, smooth boundary.

B1--8 to 16 inches, brown (7.5YR 5/3) silt loam, dark brown (7.5YR 3/2) moist; massive; slightly hard, friable, sticky and nonplastic; a few fine roots; common, fine, tubular pores; medium acid (pH 5.5); gradual, smooth boundary.

B2t--16 to 29 inches, light yellowish-brown (10YR 6/4) heavy silt loam, dark brown (7.5YR 4/4) moist; massive; hard, friable, sticky and nonplastic; a few fine roots; a few, medium, tubular pores and common, fine, tubular pores; a few thin clay films in pores and as bridges; strongly acid (pH 5.0); clear, smooth boundary.

C--29 inches, weathered, fine-grained siltstone and sandstone.

The A horizon ranges from brown to dark brown in color. The B horizon ranges from silt loam to clay loam in texture. Depth to bedrock ranges from 20 to 50 inches.

Included in mapping are small areas of Hugo loam, Josephine loam, Kneeland loam, and Laughlin loam. Also included are a few areas that have slopes of less than 30 percent.

Permeability is moderate in the subsoil of this Hely soil. Runoff is rapid, and the hazard of erosion is moderate. Fertility is moderate, and the available water capacity is about 4 to 9 inches.

This soil is used mainly for timber. If this soil is cleared or burned, the grazing value is limited. Capability unit VIe-1; woodland group 2.

Hely silt loam, 50 to 75 percent slopes (HeG).--This soil is similar to Hely silt loam, 30 to 50 percent slopes.

Included in mapping are small areas of Hugo loam, Josephine loam, and Laughlin loam.

Runoff is very rapid, and the hazard of erosion is very high.

This soil is used mainly for timber. Capability unit VIIe-1; woodland group 3.

Henneke Series

The Henneke series consists of excessively drained gravelly loams that have a very gravelly clay subsoil. These soils are underlain, at a depth of 10 to 20 inches, by serpentine bedrock. These soils are on mountainous uplands. They are mainly in the northeastern and north-central one-third of the county. There are also areas scattered throughout the mountains along the eastern side of the county. Slopes are 5 to 75 percent. Elevation ranges from 600 to 3,500 feet. Annual rainfall is 30 to 50 inches, annual temperature is 58° to 60° F., and the frost-free season is 250 to 270 days. The vegetation is chiefly scrub oak, poison oak, manzanita, annual weeds, and sparse stands of grass. The Henneke soils are associated with the Boomer, Hugo, Huse, and Montara soils.

In a typical profile the surface layer is dusky-red, neutral gravelly loam about 5 inches thick. The subsoil is dusky-red and dark reddish-brown, moderately alkaline very gravelly light clay. At a depth of about 16 inches are fragments of serpentine rock mixed with clay loam.

Henneke soils are used mainly for watershed and as wildlife habitat. A few areas are used for limited grazing.

Henneke gravelly loam, 5 to 30 percent slopes (HgE).--This moderately sloping to moderately steep soil is on uplands.

Typical profile at an elevation of 1,800 feet; slope of 28 percent that faces west, supports cypress, manzanita, California Juniper, and ceanothus; about 3 miles north-northwest of Kenwood on the southeast side of Pythian Road and about 2 miles north of the junction of Pythian Road and State Highway No. 12 on the W. Johnson ranch (SW1/4 SW1/4 sec. 7, T. 7 N., R. 6 W. projected); the profile was moist below a depth of 5 inches:

A1--0 to 5 inches, dusky-red (2.5YR 3/2) gravelly loam, very dusky red (2.5YR 2/2) moist; strong, fine, granular structure; slightly hard, friable, slightly sticky and plastic; many very fine and fine roots and common medium roots; many, very fine, interstitial pores; neutral (pH 6.8); clear, smooth boundary.

B2t--5 to 16 inches, dusky-red (2.5YR 3/2) and dark reddish-brown (2.5YR 3/4) very gravelly light clay that has grayish-white specks; dusky red (2.5YR 3/2) moist; strong, very fine, subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine roots and a few coarse roots; many, very fine, interstitial pores and common, very fine, tubular pores; many thin clay films on ped faces and in pores; moderately alkaline (pH 8.0); abrupt, smooth boundary.

R--16 inches, grayish-green serpentine rock fragments; some clay loam between rock fragments.

The A horizon ranges from dark brown to dusky red or from dark red to brown in color. Depth to rock ranges from 10 to 20 inches.

Included in mapping are small areas of Boomer loam, Hugo very gravelly loam, Huse stony clay loam, and Montara cobbly clay loam. Also included are small areas on north slopes which are not gravelly, but which have clayey subsoils. Rocks crop out in places on this Henneke soil.

Permeability is moderately slow in the subsoil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is very low. The available water capacity is 1 to 2 inches.

The main use of this soil is for watershed and as wildlife cover. A small amount of this soil is used for grazing. Capability unit VIIe-9; range site 11.

Henneke gravelly loam, 30 to 75 percent slopes, eroded (HgG2).--This soil is similar to Henneke gravelly loam, 5 to 30 percent slopes except it is steeper.

Included in mapping are small areas of Hugo very gravelly loam and Huse stony clay loam.

Runoff is rapid, and the hazard of erosion is high to very high.

The main use of this soil is for watershed and as wildlife habitat. Forage for cattle or sheep is limited. Capability unit VIIe-9; range site 11.

Hugo Series

The Hugo series consists of well-drained very gravelly loams that have a gravelly sandy clay loam subsoil. At a depth of 30 to 60 inches the soils are underlain by weathered, fine-grained sandstone and shale. These soils are on mountainous uplands. They are extensive in the northern half of the county. Slopes are 9 to 75 percent. Elevation

ranges from 800 to 3,000 feet. Annual rainfall is 25 to 70 inches, annual temperature is 52° to 56° F., and the frost-free season is 260 to 280 days. The vegetation is chiefly Douglas-fir, redwood, and California laurel, with an understory of associated hardwood species. The Hugo soils are associated with the Atwell, Josephine, Laughlin, and Maymen soils.

In a typical profile the surface layer is pale-brown, neutral very gravelly loam about 8 inches thick. Above this is a layer of loose litter of Douglas-fir needles and twigs. The subsoil is pale-brown, medium acid and strongly acid gravelly sandy clay loam and gravelly heavy loam. At a depth of about 48 inches is mixed, weathered, medium-grained sandstone (graywacke) and soil material.

Hugo soils are used mainly for timber. Some areas have been cleared and are used for grazing.

Hugo very gravelly loam, 50 to 75 percent slopes (HkG).--This very steep soil is in mountainous uplands.

Typical profile on a hillside in a stand of conifers; north-northwest-facing slope of 74 percent about 6 miles north-northeast of Fort Ross and 2.4 miles south-southwest of Hedgpeth Lake (SE1/4 NW1/4 sec. 28, T. 9 N., R. 12 W.):

O1--1/2 inch to 0, loose litter of Douglas-fir needles and twigs.

A1--0 to 8 inches, pale-brown (10YR 6/3) very gravelly loam, brown (10YR 4/3) moist; strong, fine and medium, granular structure; soft, friable, slightly sticky and slightly plastic; many very fine and fine roots and a few coarse roots; many, very fine and fine, tubular and interstitial pores; neutral (pH 6.8); diffuse boundary.

B1--8 to 16 inches, pale-brown (10YR 6/3) gravelly sandy clay loam, brown (10YR 4/3) moist; strong, fine and medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots and a few coarse roots; many, very fine and fine, tubular and interstitial pores; medium acid (pH 6.0); diffuse boundary.

B21--16 to 31 inches, pale-brown (10YR 6/3) gravelly sandy clay loam, brown (10YR 4/3-4/4) moist; strong, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots and a few coarse roots; many, very fine and fine, tubular and interstitial pores; a few medium clay films in pores and as bridges; medium acid (pH 6.0); clear, wavy boundary.

B22--31 to 48 inches, pale-brown (10YR 6/2-6/3) gravelly heavy loam, near gravelly clay loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; a few fine, medium, and coarse roots; many, very fine and fine, tubular and interstitial pores; a few medium clay films in pores and as bridges; strongly acid; (pH 5.5) diffuse boundary.

C&R--48 inches, light yellowish-brown (10YR 6/4) scattered and weathered medium-grained sandstone (graywacke) mixed with soil material, dark yellowish brown (10YR 4/4) moist; massive; hard, firm, slightly sticky and slightly plastic; medium clay films on rock fragments and along rock fractures; strongly acid (pH 5.5); grades into shattered and weathered, massive, very pale-brown, hard, medium-grained sandstone (graywacke).

The A horizon ranges in color from grayish brown to brown to light brownish gray or pale brown. The B horizon contains less than 35 percent gravel and ranges from loam to gravelly sandy clay loam in texture. Soil depth to weathered rock ranges from 30 to 60 inches.

Included in mapping are small areas of Atwell clay loam, Josephine loam, Laughlin loam, and Maymen gravelly sandy loam. Also included are areas with up to 5 percent rock outcrops on the surface.

Permeability is moderate in the subsoil of this Hugo soil. Runoff is very rapid, and the hazard of erosion is very high. Fertility is moderate. The available water capacity is 4 to 8 inches.

This soil is used mainly for producing timber. Some areas that have been logged are used for grazing. Capability unit VIIe-4; woodland group 6.

Hugo very gravelly loam, 30 to 50 percent slopes (HkF).--This soil is similar to Hugo very gravelly loam, 50 to 75 percent slopes, but it is not so steep. The gravel content varies from 25 to 45 percent by volume.

Included in mapping are small areas of Josephine loam, Laughlin loam, and Maymen gravelly sandy loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 8 inches.

This soil is used mainly for timber. Capability unit VIe-4; woodland group 2.

Hugo very gravelly loam, 50 to 75 percent slopes, eroded (HkG2).--This soil is similar to Hugo very gravelly loam, 50 to 75 percent slopes, but erosion is evident in this soil. As a result of erosion, the thickness of the surface layer is reduced and the depth to rock generally is only 30 to 40 inches.

Included in mapping are small areas of Josephine loam, Laughlin loam, and Maymen gravelly sandy loam.

The available water capacity is 4 to 6 inches.

This soil is used mainly for timber. Capability unit VIIe-4; woodland group 6.

Hugo loam, 30 to 50 percent slopes (HhF).--This soil is similar to Hugo very gravelly loam, 50 to 75 percent slopes, but the surface layer contains less than 15 percent gravel by volume.

Included in mapping are small areas of Atwell clay loam, Josephine loam, and Laughlin loam.

Runoff is rapid, and the hazard of erosion is high. This soil ranges in depth from 36 to 60 inches. The available water capacity is 5 to 10 inches.

This soil is used mainly for timber. Some areas have been used for limited grazing. Capability unit VIe-1; woodland group 5.

Hugo-Atwell complex, 30 to 50 percent slopes (HlF).--This complex is in the northern and western areas of the county on sandstone and shale of the Franciscan formation. It is also between Camp Meeker and north to the Russian River, where there is a large proportion of metamorphosed sandstone and shale. The Hugo soils make up about 70 percent of the complex; Atwell soils, about 20 percent; Melbourne soils, about 5 percent; and Josephine soils, the remaining 5 percent. Stoniness ranges from 15 to 30 percent.

The Hugo soils have predominantly concave slopes. The Atwell soils have convex slopes and occur near water courses. Occasional landslips are common on Atwell soils. The quality of timber is lower on Atwell soils than on Hugo soils.

The Hugo soil has a profile similar to Hugo very gravelly loam, 50 to 75 percent slopes. Soil depth is 30 to 50 inches. Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 7.5 inches.

The Atwell soil has a profile similar to Atwell clay loam, 30 to 50 percent slopes. Soil depth is 30 to 50 inches. Surface runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for timber. Capability unit VIe-4; Hugo, woodland group 2; Atwell, woodland group 8.

Hugo-Atwell complex, 50 to 75 percent slopes (HlG).--This complex is similar to the Hugo-Atwell complex, 30 to 50 percent slopes. Stoniness ranges from 15 to 30 percent by volume. Hugo soils make up about 75 percent of the complex; Atwell soils, about 20 percent; Hely soils make up the remaining 5 percent.

The Hugo soils have a profile similar to that of Hugo very gravelly loam, 50 to 75 percent slopes. Runoff is very rapid, and the hazard of erosion is very high.

The Atwell soils have a profile similar to that of Atwell clay loam, 30 to 50 percent slopes. Runoff is very rapid, and the hazard of erosion is very high.

These soils are used mainly for timber. Capability unit VIIe-4; Hugo, woodland group 2; Atwell, woodland group 8.

Hugo-Boomer complex, 30 to 50 percent slopes (HmF).--This complex is primarily in the vicinity of Ross mountain, west of Cazadero. Parent material is black schist. Hugo very gravelly loam makes up about 70 percent of this complex; and Boomer loam, about 25 percent; and about 5 percent is made up of Josephine soils. Stoniness ranges from 15 to 40 percent by volume, primarily in the Hugo soils.

The Hugo soils have a profile similar to that of Hugo very gravelly loam, 50 to 75 percent slopes. Runoff is rapid, and the hazard of erosion is high.

The Boomer soils have a profile similar to that of Boomer loam, 50 to 75 percent slopes. Runoff is rapid, and the hazard of erosion is high.

The soils are used for timber. Capability unit VIe-4; woodland group 2.

Hugo-Boomer complex, 50 to 75 percent slopes (HmG).--This complex is similar to Hugo-Boomer complex, 30 to 50 percent slopes. About 80 percent of this complex is made up of Hugo very gravelly loam, and about 20 percent is Boomer loam. Depth ranges from 30 to 60 inches, and stoniness and gravel range from 15 to 45 percent by volume, primarily on the Hugo soils.

Hugo soils have a profile similar to that of Hugo very gravelly loam, 50 to 75 percent slopes. Runoff is very rapid, and the hazard of erosion is very high.

Boomer soils have a profile similar to that of Boomer loam, 50 to 75 percent slopes. Runoff is very rapid, and the hazard of erosion is very high.

The soils are used for timber. Capability unit VIIe-4; Hugo, woodland group 6; Boomer, woodland group 3.

Hugo-Josephine complex, 9 to 30 percent slopes (HnE).--This complex is scattered throughout the northwestern part of the county. Hugo loam makes up about 70 percent of the complex, and Josephine loam about 30 percent. In some areas about 10 to 15 miles west of Cloverdale, small bodies of Laughlin loam occupy about 5 percent of the complex. In the western section of the large, timbered, northwestern part of the county near the ocean, some of this complex joins the coarser textured soils of Mendocino, Empire, and Goldridge series. Inclusions of small bodies of one or more of these soils make up 1 to 3 percent of this complex.

Hugo soils have a profile similar to that of Hugo very gravelly loam, 50 to 75 percent slopes, but it contains about 10 to 20 percent gravel throughout. This soil is 30 to 50 inches deep. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is moderate. The available water capacity is 4 to 7.5 inches.

Josephine soils have a profile similar to that of Josephine loam, 50 to 75 percent slopes. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for timber. Some hillsides have been cleared and are used for limited grazing. Capability unit VIe-1; woodland group 1.

Hugo-Josephine complex, 50 to 75 percent slopes (HnG).--This complex is in the northwestern part of the county and north and east of Geyserville. Some areas are in the vicinity of Camp Meeker and Monte Rio. Others are in the northwestern part of the county near Mendosoma Forestry Station and include about 2 percent Atwell soil. Hugo very gravelly loam makes up about 60 percent of the complex, and Josephine loam about 40 percent.

The Hugo very gravelly loam in this complex has a profile similar to that of Hugo very gravelly

loam, 50 to 75 percent slopes. Runoff is very rapid, and the erosion hazard is very high.

The Josephine loam in this complex has a profile similar to that of Josephine loam, 50 to 75 percent slopes. Runoff is very rapid, and the erosion hazard is very high.

These soils are used for timber, particularly redwood and Douglas-fir. They are used for range and pasture where the soils have been logged and cleared. Capability unit VIIe-4; Hugo, woodland group 6; Josephine, woodland group 3.

Hugo-Josephine complex, 50 to 75 percent slopes, eroded (HnG2).--The soils in this complex are similar to the Hugo-Josephine complex, 50 to 75 percent slopes, but they have been subjected to sheet and gully erosion generally because of poor logging methods. In some stripped areas, overgrazing of browse and the limited forage has caused damage to the soils.

This complex is in the northwestern part of the county and in areas located 5 to 6 miles southeast of Healdsburg and 6 to 10 miles southwest and west of Cloverdale. Some areas have been mapped in the upper watershed of Dry Creek. Hugo very gravelly loam makes up about 60 percent of this complex, and Josephine loam about 40 percent. Also included in this complex are some of the scattered areas of Laughlin loam and Los Gatos loam. Generally, these soils are very steep, but some areas that have slopes of less than 50 percent are also included. Stones cover from 5 to 30 percent of the surface by volume.

The Hugo soils are 20 to 30 inches deep. The available water capacity is 3 to 4 inches. Runoff is very rapid, and the hazard of erosion is very high.

The Josephine soils are 30 to 40 inches deep. The available water capacity is 4 to 5 inches. Runoff is very rapid, and the hazard of erosion is very high.

These soils are used for timber and for limited grazing. Capability unit VIIe-4; woodland group 6.

Hugo-Laughlin complex, 30 to 75 percent slopes (HoG).--This complex is scattered throughout the northern part of the county. Hugo gravelly loam makes up about 60 percent of the complex and Laughlin loam about 35 percent. This complex also includes about 3 percent Suther soils and 2 percent Los Gatos soils.

The Hugo soils have a profile similar to that of Hugo very gravelly loam, 50 to 75 percent slopes, but contain about 10 to 20 percent gravel throughout the profile. Runoff is very rapid, and the hazard of erosion is very high. The effective depth of rooting is 30 to 50 inches. The available water capacity is 4 to 7.5 inches.

The Laughlin soils have a profile similar to that of Laughlin loam, 50 to 75 percent slopes. The soil depth is 20 to 30 inches. The available water capacity is 3 to 4 inches. Runoff is very rapid, and the hazard of erosion is very high.

These soils are used for timber, and where they have been cleared, they are used for range and pasture. Capability unit VIIe-8; Laughlin, range site 3; Hugo, woodland group 6.

Hugo-Los Gatos complex, 50 to 75 percent slopes (HrG).--This complex is south of Skaggs Springs, between Las Lomas and Skaggs Springs. The soils are gravelly and stony, but stones are more common on the Los Gatos soils than on the Hugo soils. The vegetation is chiefly grass, oak, shrub, and scattered redwood and Douglas-fir. Hugo very gravelly loam makes up 70 percent of the complex, and Los Gatos loam about 25 percent. Included with these soils are about 3 percent Laughlin soils and 2 percent Josephine soils. Laughlin soils generally occur on ridgetops. The entire complex is very steep.

Hugo soils have a profile similar to that of Hugo very gravelly loam, 50 to 75 percent slopes. They are 30 to 50 inches deep. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is 4 to 7 inches.

Los Gatos soils have a profile similar to that of Los Gatos loam, 30 to 75 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

These soils are used mainly for range, watershed, and as wildlife habitat. Some areas are used for limited grazing. Capability unit VIIe-4; Los Gatos, range site 10; Hugo, woodland group 6.

Hugo-Hely complex, 30 to 50 percent slopes (HsF).--This complex is in the central, western, and northwestern uplands of the county. Hugo very gravelly loam and Hely silt loam each make up about 50 percent of the complex. The Hugo soils generally have convex slopes. The Hely soils occupy concave position. Stones range from 10 to 20 percent by volume.

Hugo soils have a profile similar to that of Hugo very gravelly loam, 50 to 75 percent slopes. They are 30 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 6 inches.

Hely soils have a profile similar to that of Hely silt loam, 30 to 50 percent slopes. They are 30 to 50 inches deep. Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4.5 to 6 inches.

These soils are used for timber. Capability VIe-4; woodland group 2.

Hugo-Hely complex, 50 to 75 percent slopes (HsG).--This complex is similar to Hugo-Hely complex, 30 to 50 percent slopes, but it is steeper and more extensive. Hugo very gravelly loam and Hely silt loam each make up about 50 percent of this complex. Stoniness varies from 15 to 30 percent by volume.

Runoff is very rapid, and the hazard of erosion is very high.

These soils are used for timber. Capability unit VIIe-4; Hugo, woodland group 6; Hely, woodland group 3.

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Huichica Series

The Huichica series consists of moderately well-drained and somewhat poorly drained loams that have a clay subsoil. At a depth of 25 to 40 inches the soils are underlain by strongly cemented old valley alluvium from mixed sedimentary, volcanic ash, and basic rock sources. These soils are on hummocky plains and terraces. They are on the plains west and northwest of Santa Rosa and in the vicinity of the town of Sonoma. Slopes are 0 to 15 percent. Elevation ranges from 100 to 300 feet. Annual rainfall is 25 to 35 inches, annual temperature is 60° to 62° F., and the frost-free season is 260 to 280 days. In uncultivated areas the vegetation is chiefly annual and perennial grasses, forbs, and scattered oaks. Most areas have been cleared and have a cover of hay or pasture, or are used for vineyards. The Huichica soils are associated with the Clear Lake, Haire, Wright, and Zamora soils.

In a typical profile the surface layer is light brownish-gray, pale-brown, and brown, strongly acid loam about 14 inches thick, underlain by a light-gray strongly acid light sandy clay loam. At a depth of 23 inches the light brownish-gray medium acid clay subsoil is about 7 inches thick. The substratum, at a depth of 30 inches, is strongly cemented mixed sandy loam, loamy sand, and sandy clay loam.

Huichica soils are used mainly for dryland and irrigated pasture and for hay crops. A few areas are used for vineyards and prune orchards.

Huichica loam, 0 to 2 percent slopes (HtA).--This nearly level soil is on undulating low valley terraces. Many of the slopes show a hummocky, or "hog wallow" micro relief.

Typical profile in a hummocky pasture; slope of 1 percent; at the Loamite Company (SW1/4 SW1/4 sec. 19, T. 9 N., R. 8 W.); the profile was dry to a depth of 23 inches when examined:

A11--0 to 7 inches, light brownish-gray (10YR 6/2) loam that has common, medium, distinct yellowish-brown mottles; dark brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine and fine, tubular pores; strongly acid (pH 5.4); gradual, wavy boundary.

A12--7 to 14 inches, pale-brown and brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine and fine, interstitial and tubular pores; strongly acid (pH 5.5); clear, wavy boundary.

A2--14 to 23 inches, light-gray (10YR 7/2) light sandy clay loam that has many, fine, faint, brown mottles; brown (10YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine and fine, tubular and interstitial pores; slightly acid (pH 6.1); abrupt, wavy boundary.

B2t--23 to 30 inches, light brownish-gray (10YR 6/2) clay, very dark grayish brown (10YR 3/2) moist; strong, coarse, columnar structure; top and sides of columns coated with ashy gray film; extremely hard, very firm, very sticky and very plastic; many very fine roots; many, very fine and fine, tubular and interstitial pores; continuous thick clay films on ped faces, as bridges, and in pores; neutral (pH 6.7); abrupt, irregular boundary.

IIC1m--30 to 36 inches, white (2.5Y 8/2) strongly cemented hardpan variegated with light olive brown; when moist, dark brown (10YR 4/3) and having light olive-brown mottles; massive; a few fine roots; mildly alkaline (pH 7.7); gradual, irregular boundary.

IIC2m--36 to 47 inches, white (2.5Y 8/2) strongly cemented hardpan that has common, fine, distinct strong-brown mottles; dark brown (10YR 4/3) moist; massive; manganese stains and continuous thick clay films on fracture planes; mildly alkaline (pH 7.6); clear, wavy boundary.

IIIC3m--47 to 60 inches, white (10YR 8/2) strongly cemented hardpan; when moist, grayish brown (10YR 5/2) and having common, fine, faint, yellowish-brown mottles; massive; continuous, thick clay films on fracture plains; neutral (pH 7.3).

The A1 horizon ranges from grayish-brown to yellowish-brown or from light brownish-gray to pale brown or brown in color and from loam to sandy loam in texture. Depth to the clay Bt horizon ranges from 20 to 30 inches. The A2 horizon, just above the Bt horizon, ranges from one-half inch to 10 inches in thickness and is intermittent. The IIC horizon varies from weakly to strongly cemented.

Included in mapping are small areas of Clear Lake clay, Haire gravelly loam, Wright loam, and Zamora silty clay loam.

Permeability is very slow in the subsoil of this Huichica soil. Runoff is slow, and the hazard of erosion is slight. Fertility is moderate. The available water capacity is 3.5 to 5 inches. Some moisture is slowly available from the clay subsoil. This soil is moderately well drained.

Nearly all of this soil has been cultivated and is used mainly for vineyards, prune orchards, and pasture. Where water is available, the crops are irrigated. Capability unit IIIs-3.

Huichica loam, 2 to 9 percent slopes (HtC).--This soil is similar to Huichica loam, 0 to 2 percent slopes, but the clay or hardpan substratum may be a few inches nearer the surface. It usually is on the edges of the low mounds or as side slopes of small drainageways.

Included in mapping are small areas of Haire gravelly loam and Wright loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The effective rooting depth is 20 to 30 inches.

This soil is used mainly for prune orchards, grapes, and pasture. Capability unit IIIe-3.

Huichica loam, 9 to 15 percent slopes (HtD).--This soil is similar to Huichica loam, 0 to 2 percent slopes, but up to 15 percent by volume may be waterwashed gravel. This soil occurs primarily in the northwestern Santa Rosa plains adjacent to the Laguna.

Included in mapping are small areas of Haire loam and Haire gravelly loam. In a few areas, overuse and the wrong cultivation methods have resulted in some soil loss.

Runoff is medium and the hazard of erosion is moderate. The available water capacity is about 2 to 4 inches. The effective rooting depth is 12 to 24 inches.

This soil is used mainly for pasture. Some areas are used for growing grapes and prunes. Capability unit IVe-3.

Huichica loam, ponded, 0 to 5 percent slopes (HuB).--This soil is similar to Huichica loam, 0 to 2 percent slopes, but the clay subsoil is generally 8 to 12 inches thicker. This soil is subject to ponding. The subsoil is thicker on the short side-slopes and small swales where water has ponded. The hummocky areas stay wet longer after the rainy season, and plants on this soil develop slower but stay green longer than those on adjacent areas that have better surface drainage.

Included in mapping are small areas of Clear Lake clay, Wright loam, and Zamora silty clay loam.

Runoff water is ponded, and the hazard of erosion is none to slight. This soil is somewhat poorly drained.

This soil is used mainly for growing grapes and prunes and for dryaland and irrigated pasture. Capability unit IIIw-3.

Huichica loam, shallow, 0 to 9 percent slopes (HvC).--This soil is similar to Huichica loam, 0 to 2 percent slopes, but the depth to the clay subsoil varies from 12 to 20 inches. In some places there is no subsurface layer.

Included in mapping are small areas of Clear Lake clay, Wright loam, and Zamora silty clay loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is about 2 to 3.5 inches.

The uses for this Huichica soil are similar to those of Huichica loam, 0 to 2 percent slopes. Capability unit IVe-3.

Huichica loam, shallow, ponded, 0 to 5 percent slopes (HwB).--This soil is similar to Huichica loam, 0 to 2 percent slopes, but it is subject to ponding. Depth to the clay subsoil varies from 12 to 20 inches.

Included in mapping are small areas of Clear Lake clay, Wright loam, and Zamora silty clay loam.

Runoff water is ponded, and the hazard of erosion is none to slight. The available water capacity is about 2 to 3.5 inches. This soil is somewhat poorly drained.

The main use of this soil is for pasture. A few fields are used for growing grapes and prunes. Capability unit IVw-3.

Huse Series

The Huse series consists of well-drained stony clay loams that have a silty clay loam subsoil. At a depth of 12 to 25 inches they are underlain by strongly weathered serpentine and peridotite. These soils are on mountainous uplands. They are in areas scattered across the northern part of the county. Slopes are 30 to 75 percent. Elevation ranges from 800 to 2,000 feet. Annual rainfall is 30 to 60 inches, annual temperature is 52° to 54° F., and the frost-free season is 225 to 250 days. The vegetation is chiefly chamise, chapparal, and shrub oak, and there are some grasses and forbs. A few areas are in stands of timber trees; these are conifers of poor quality, chiefly Douglas-fir, Digger pine, and cypress. The Huse soils are associated with the Boomer, Henneke, Los Gatos, and Maymen soils.

In a typical profile the surface layer is dark reddish-brown, slightly acid stony clay loam about 4 inches thick. This layer is covered with about 2 inches of duff litter. The subsoil is dark-red, reddish-brown, and reddish-yellow silty clay loam and gravelly silty clay loam. Reaction is neutral in the subsoil. At a depth of about 22 inches is weathered serpentine, peridotite, and some clay loam.

Huse soils are used for limited grazing by sheep and cattle, as well as for watershed and as wildlife habitat. A few of the wooded areas have been used as a source for lumber.

Huse stony clay loam, 30 to 75 percent slopes (HyG).--This steep or very steep soil is on mountainous uplands.

Typical profile on a hillside; convex, east-facing slope of 45 percent; 2.75 miles west of Daniels School on Mill Creek Road (NE1/4 SW1/4 sec. 26, T. 9 N., R. 11 W); the profile was dry when examined:

O1--2 inches to 0, duff litter.

A1--0 to 4 inches, dark reddish-brown (2.5YR3/4) stony clay loam, dark reddish brown (2.5YR 2/4) moist; strong, medium, granular structure; soft, friable, nonsticky and slightly plastic; common fine roots and many medium roots; many, fine, interstitial pores; slightly acid (pH 6.3); a few fungal mycelia; 5 percent gravel by volume; clear, wavy boundary.

B1--4 to 11 inches, dark-red (2.5YR 3/6) silty clay loam, dark reddish brown (2.5YR 3/4) moist; moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly

plastic; common fine and coarse roots and many medium roots; common, very fine, tubular and interstitial pores; neutral (pH 6.7); a few fungal mycelia; 10 percent gravel by volume; gradual, smooth boundary.

B21--11 to 17 inches, dark-red (2.5YR 3/6) silty clay loam, dark reddish brown (2.5YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; a few very fine, common fine, and many medium roots; common, very fine, tubular pores; common thin clay films in pores; neutral (pH 7.0); 15 percent gravel, by volume; gradual, smooth boundary.

B22--17 to 22 inches, reddish-brown (5YR 4/4) and reddish-yellow (7.5YR 6/6) gravelly silty clay loam, dark reddish brown (2.5YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; a few very fine, common fine, and many medium roots; common, very fine, tubular pores; a few thin clay films in pores; neutral (pH 7.0); 30 percent gravel by volume; gradual, smooth boundary.

C&R--22 inches, strongly weathered serpentine and peridotite; clay loam is mixed with rocky material.

The A horizon ranges from loam to silty clay loam in texture and from dark reddish-brown to red in color. This horizon is stony or very stony. The B horizon is 5 to 30 percent gravel, by volume. Depth to bedrock ranges from 12 to 25 inches.

Included in mapping are small areas of Boomer loam, Henneke gravelly loam, Los Gatos gravelly loam, and Maymen gravelly sandy loam.

Permeability is moderate in the subsoil of this Huse soil. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Fertility is very low, and the available water capacity is 2 to 5 inches.

This soil is used for range. Capability unit VIIe-9; range site 11.

Josephine Series

The Josephine series consists of well-drained loams that have a clay loam subsoil. At a depth of 24 to over 60 inches they are underlain by weathered, fine-grained sandstone and shale. These soils are on mountainous uplands. They are in the northern half of the county. Slopes are 9 to 75 percent. Elevation ranges from 600 to 3,000 feet. Annual rainfall is 25 to 70 inches, annual temperature is 52° to 54° F., and the frost-free season is 240 to 260 days. In most places the vegetation is chiefly Douglas-fir, redwood, California laurel, and associated kinds of hardwood as understory. Some areas have been cleared and have a cover of fern, broom, and grasses. The Josephine soils are associated with the Boomer, Hugo, Laughlin, and Mendocino soils.

In a typical profile the surface layer is light-brown, medium acid loam about 13 inches thick. This layer is covered with a thin organic litter of madrone and Douglas-fir. The subsoil is light reddish-brown, medium acid clay loam and, at a depth of 25 inches, is underlain by light reddish-brown, medium acid fine sandy loam. At a depth of about 36 inches, is fine-grained sandstone and shale.

Josephine soils are used mainly for timber. The cleared areas are used for grazing.

Josephine loam, 50 to 75 percent slopes (JoG).--This soil is on coast range mountainous terrain. Slopes are very steep and are fairly long, concave or convex, single or complex.

Typical profile at an elevation of 620 feet; concave slope of 52 percent; supports Douglas-fir, black oak, and madrone; at the junction of Wolf Creek and the Wheatfield fork of the Gualala River, about 2 miles north of the Hedgpeth homestead (NW1/4 NE1/4 sec. 32, T. 10 N., R. 12 W.):

O1--1 inch to 0, madrone and Douglas-fir organic litter.

A1--0 to 13 inches, light-brown (7.5YR 6/4) loam, dark reddish brown (5YR 3/3) moist; moderate, fine, granular structure; soft, very friable, slightly sticky, and nonplastic; common roots; common interstitial pores; a few thin clay films; medium acid (pH 6.0); diffuse, smooth boundary.

B21t--13 to 20 inches, light reddish-brown (5YR 6/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common roots; common interstitial pores; medium acid (pH 6.0); gradual, irregular boundary.

B22t--20 to 25 inches, light reddish-brown (5YR 6/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium, subangular blocky structure; soft, friable, slightly sticky and slightly plastic; a few coarse roots and common fine roots; common interstitial pores; medium acid, (pH 6.0); gradual, irregular boundary.

B3--25 to 36 inches, light reddish-brown (5YR 6/4) fine sandy loam, yellowish red (5YR 4/6) moist; massive; soft, friable, slightly sticky and nonplastic; a few coarse roots and common fine roots; medium acid (pH 6.0); gradual, irregular boundary.

C--36 inches, fine-grained sandstone and shale.

The thickness of the O1 horizon ranges from 1 to 3 inches. The A horizon ranges from yellowish brown or red to light brown in color and from gravelly loam to loam or sandy clay loam in texture. The B horizon ranges from light reddish brown or reddish brown to yellowish red in color. Thick clay films in pores and as bridges range from none to many. This horizon ranges from strongly to slightly acid. Thickness ranges from 24 to more than 60 inches. Content of gravel and stone ranges from none to 35 percent throughout the profile.

Included in mapping are small areas of Boomer loam, Hugo very gravelly loam, Laughlin loam, and Mendocino sandy clay loam.

Permeability is moderate in the subsoil of this Josephine soil. Runoff is very rapid, and the hazard of erosion is very high. Fertility is moderately high, and the available water capacity is 4 to 10 inches.

The main use of this soil is for timber. If cleared or burned, the grazing value is limited. Capability unit VIIe-1; woodland group 3.

Josephine loam, 9 to 30 percent slopes (JoE).--This soil is similar to Josephine loam, 50 to 75 percent slopes, but ranges in depth from 36 to 60 inches, although much of the acreage is 45 inches deep or more. Content of stone and gravel ranges from none to 20 percent, by volume.

Included in mapping are small areas of Hugo very gravelly loam, Laughlin loam, and Mendocino sandy clay loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 6 to 10 inches.

The main use of this soil is for timber. Attempts at growing orchards and vineyards have been generally unsuccessful. Capability unit IVe-1; woodland group 1.

Josephine loam, 30 to 50 percent slopes (JoF).--This soil is similar to Josephine loam, 50 to 75 percent slopes, but it ranges in depth from 30 to 60 inches. Generally depth is 40 to 50 inches. Content of gravel and stone ranges from little or none to about 15 percent.

Included in mapping are small areas of Boomer loam, Hugo very gravelly loam, and Laughlin loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 5 to 10 inches.

This soil is used mainly for timber. Capability unit VIe-1; woodland group 2.

Josephine loam, 30 to 50 percent slopes, eroded (JoF2).--This soil is similar to Josephine loam, 50 to 75 percent slopes, but there is evidence of past erosion. Because of the erosion, the soil ranges in depth from 24 to 40 inches.

Included in mapping are small areas of Hugo very gravelly loam, Laughlin loam, and Mendocino sandy clay loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 7 inches.

The main use of this soil is for producing timber. Capability unit VIe-1; woodland group 2.

Josephine-Sites loams, 30 to 75 percent slopes (JsG).--This complex generally is very inextensive. Both soils in this complex are 36 to 60 inches deep over bedrock. They occur in equal proportions in the northwest ranges of the county. A few small areas occur 5 to 10 miles west and southwest of Cloverdale. Sites loam generally is not so steep as Josephine loam. Included in mapping are areas of Hugo soils. These soils generally have slopes of 50 to 75 percent. They occupy about 3 percent of the complex.

Josephine loam has a profile similar to that of Josephine loam, 50 to 75 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Fertility is moderate.

Sites loam has a profile similar to that of Sites loam, 5 to 30 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Fertility is moderate.

These soils are used mainly for timber. Some cleared areas are used for grazing. Capability unit VIIe-1; Josephine, woodland group 3; Sites, woodland group 7.

Kidd Series

The Kidd series consists of somewhat excessively drained gravelly loams. They are underlain, at a depth of 5 to 20 inches, by rhyolite rock and rhyolitic tuff. These soils are on mountainous uplands. They are in the eastern part of the county from Mt. St. Helena south to Arrowhead Mountain near the town of Sonoma. Slopes are 2 to 75 percent. Elevation ranges from 1,000 to 4,000 feet. Annual rainfall is 30 to 60 inches, annual temperature is 50 to 56° F., and the frost-free season is 240 to 260 days. The vegetation is chiefly annual grasses, chamise, manzanita, and other small brush. The Kidd soils are associated with the Forward, Goulding, Henneke, and Laniger soils.

In a typical profile the surface layer is pale-brown, slightly acid gravelly loam about 8 inches thick. The subsoil is very pale-brown, medium acid gravelly loam. At a depth of about 15 inches is mixed rhyolitic tuff and hard rhyolite rock.

Kidd soils are used mainly for watershed and recreational purposes. A few, scattered, cleared areas are used for limited grazing by sheep and cattle.

Kidd gravelly loam, 9 to 50 percent slopes (KdF).--This strongly sloping to steep soil is on uplands. In most places slopes range from 30 to 50 percent.

Typical profile on Ida Clayton Road, 1 mile north of Knights Valley (NE1/4 SW1/4 sec. 5, T. 9 N., R. 7 W.); the profile was dry when examined:

A1--0 to 8 inches, pale-brown (10YR 6/3) gravelly loam, dark brown (10YR 4/3) moist; moderate, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; a few coarse roots and common medium roots; a few, very fine, interstitial pores; slightly acid (pH 6.5); gradual, smooth boundary.

B2--8 to 15 inches, very pale-brown (10YR 7/4) gravelly loam, dark brown (7.5YR 4/4) moist; moderate, medium, granular structure; slightly hard, friable, sticky and slightly plastic; a few coarse and medium roots and many fine roots; a few, very fine, interstitial

pores; a few thin clay films as colloidal stains on mineral grains; medium acid (pH 6.0); clear, wavy boundary.

R--15 inches, mostly rhyolite rocks and rhyolitic tuff; soil in crevices.

The A horizon ranges from pale brown to very pale brown in color. Depth to bedrock ranges from 5 to 15 inches. Gravel content varies from 15 to 35 percent throughout the profile.

Included in mapping are small areas of Forward gravelly loam, Goulding cobbly clay loam, Henneke gravelly loam, and Laniger loam. Also included are areas of rhyolitic rock outcrops.

Permeability is rapid in the subsoil of this Kidd soil. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is low. The available water capacity is 0.75 inch to 2 inches.

The main use of this soil is for range. This soil is also used for watershed, recreational purposes, and as wildlife habitat. Capability unit VIIe-8; range site 10.

Kidd stony loam, 2 to 30 percent slopes (KeE).--This soil is similar to Kidd gravelly loam, 9 to 50 percent slopes, but it is 12 to 20 inches deep. Stones cover .01 to .1 percent of the surface.

Included in mapping are small areas of Forward gravelly loam, Goulding cobbly clay loam, and Laniger loam. Also included are scattered areas of basaltic and rhyolitic rock outcrops.

The available water capacity is 1.5 to 3 inches.

This soil is used mainly for pasture and range. Capability unit VIe-8; range site 10.

Kidd very rocky loam, 30 to 75 percent slopes (KkG).--This soil is in the vicinity of Sonoma Valley, northeastern Santa Rosa, and north of Knights Valley on the slopes of Mt. St. Helena. Outcrops of rhyolite and rhyolitic tuff occupy 10 to 25 percent of the surface area.

Included in mapping are small areas of Forward gravelly loam, Henneke gravelly loam, and Laniger loam.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is about 1.5 to 3 inches. The effective rooting depth is 12 to 20 inches.

These soils are used mainly for range. Capability unit VIIs-8; range site 10.

Kinman Series

The Kinman series consists of moderately well-drained loams that have a clay subsoil. At a depth of 30 to more than 60 inches they are underlain by fine-grained, hard, sedimentary rocks. These soils are on hilly uplands along the western coast of the county and from 1 to 4 miles inland. Slopes are 5 to 50 percent. Elevation ranges from 100 to 1,500 feet. Annual rainfall is 30 to 40 inches, annual temperature is 52° to 55° F., and the frost-free season is 290 to 310 days. The vegetation is chiefly annual and perennial grasses, shrubs, and forbs, but a few areas have a cover of oak and brush. The Kinman soils are associated with the Kneeland, Laughlin, Rohnerville, and Yorkville soils.

In a typical profile the surface layer generally is dark grayish-brown, medium acid loam and clay loam about 12 inches thick. The subsoil is dark grayish-brown and light olive-brown, medium acid to neutral clay about 42 inches thick, with dark grayish-brown, yellowish-brown or brownish-yellow mottles. At a depth of about 54 inches is weathered sandstone mixed with soil material.

Kinman soils are used mostly for pasture for sheep and cattle. A few small areas on gentler slopes are used for oat hay.

Kinman loam, 30 to 50 percent slopes (KlF).--This steep soil is on uplands. Most of the slopes are long and smooth. In most places, slopes range from 30 to 40 percent.

Typical profile in a pasture in fair condition; 33 percent slope that faces southeast; 0.25 mile northwest of the abandoned Ocean District school building (NW1/4 SW1/4 sec. 21, T. 7 N., R. 11 W.); the profile was dry when examined:

A11--0 to 7 inches, dark grayish-brown (2.5Y 4/2) loam, very dark gray (10YR 3/1) moist; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; many medium and fine roots; many tubular and interstitial pores; a few thin clay films on ped faces and in pores; medium acid (pH 6.0); 10 percent rock fragments; diffuse, smooth boundary.

A12--7 to 12 inches, dark grayish-brown (2.5Y 4/2) clay loam, very dark gray (10YR 3/1) moist; moderate, coarse, subangular blocky structure; hard, friable, sticky and very plastic; many very fine, fine, and medium roots; many tubular and interstitial pores; a few thin clay films on ped faces and in pores; a few large rock fragments; medium acid (pH 6.0); clear, wavy boundary.

B21t--12 to 17 inches, dark grayish-brown (2.5Y 4/2) clay; when moist, olive brown (2.5Y 4/4) and having common, medium, distinct, dark grayish-brown mottles; strong, coarse, subangular blocky structure; very hard, firm, very sticky and very plastic; common fine roots; many tubular and intsertitial pores; many, moderately thick clay films on sand grains, on ped faces, and in pores; medium acid (pH 6.0); 20 percent rock fragments; diffuse, wavy boundary.

B22t--17 to 22 inches, light olive-brown (2.5Y 5/4) clay; when moist, brown (10YR 5/3) and having common, medium, distinct, yellowish-brown and brownish-yellow mottles; strong, medium, prismatic and strong, coarse, subangular blocky structure; very hard, firm, sticky and plastic; many medium and fine roots; many tubular pores; many moderately thick clay films on sand grains, on ped faces, and in pores; medium acid (pH 6.0); diffuse, wavy boundary.

B23t--22 to 33 inches, light olive-brown (2.5Y 5/4) clay; when moist, brown (10YR 5/3) and having many, large, prominent, brownish-yellow mottles; strong, medium, prismatic and strong, coarse, subangular blocky structure; very hard, firm, sticky and plastic; a few micro roots; many moderately thick clay films on sand grains, on ped faces, and in pores; slightly acid (pH 6.5); diffuse, wavy boundary.

B24t--33 to 54 inches, light olive-brown (2.5Y 5/4) clay; when moist, brown (10YR 5/3) and having many large, prominent, light yellowish-brown and yellowish-brown mottles; strong, medium, prismatic and strong, coarse, subangular blocky structure; very hard, very firm, sticky and plastic; many, tubular and insterstitial pores; continuous moderately thick clay films on sand grains, on ped faces, and in pores; neutral (pH 7.0); many old root channels and stains; clear, irregular boundary.

C&R--54 inches, weathered sandstone mixed with soil similar to above horizon.

The A horizon ranges from gray to dark grayish-brown in color, and from slightly acid to strongly acid. Typically, the soil becomes less acid with depth, but in some areas that are a short distance inland from the coast, the Bt horizon may have about the same reaction as the A horizon. Depth to rock varies from 30 to 55 inches. Some of the steeper slopes have old slip areas that are nearly stabilized.

Included in mapping are small areas of Kneeland loam, Laughlin loam, Rohnerville loam, and Yorkville clay loam. Also included are scattered areas of large rock outcrops sometimes called "sea stacks."

Permeability is slow in the subsoil of this Kinman soil. Runoff is rapid, and the hazard of erosion is high. Fertility is moderate. The available water capacity is 4.5 to 8 inches.

This soil is used mainly for grazing by sheep and cattle. Capability unit VIe-3; range site 6.

Kinman loam, 5 to 15 percent slopes (KlD).--This soil is similar to Kinman loam, 30 to 50 percent slopes, but it is 40 to more than 60 inches deep over bedrock.

Included in mapping are small areas of Kneeland loam and Rohnerville loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 6 to 10 inches.

Small areas on the gentler slopes have been seeded for oat hay, but this soil is used mainly for sheep pasture. Capability unit IVe-3; range site 2.

Kinman loam, 15 to 30 percent slopes (KlE).--This soil is similar to Kinman loam, 30 to 50 percent slopes, but the depth to the bedrock is deeper. The surface layer and subsoil combined are about 40 to more than 60 inches thick.

Included in mapping are small areas of Kneeland loam, Lauglin loam, and Yorkville clay loam. Also included are scattered areas of a dark-gray clay, generally near the areas of the Yorkville series. Occasionally, there are outcrops of hard sandstone.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is about 6 to 10 inches.

The soil is used mainly for sheep pasture and for range. Capability unit VIe-3; range site 2.

Kinman-Kneeland loams, 30 to 50 percent slopes (Kmf).--This complex is above the coastal terraces between Bodega Bay and the vicinity of Jenner. Kinman loam makes up about 60 percent of the complex, and Kneeland loam about 40 percent. Included with these soils are areas of soils that have slopes of less than 30 percent or greater than 50 percent. The lesser slopes usually occur on broad ridgetops. Rock outcrops cover less than 2 percent of the surface. Seepage is common on the lower toeslopes of the Kinman soils.

Kinman loam has a profile similar to that of Kinman loam, 30 to 50 percent slopes. Depth to sandstone and shale is 30 to 45 inches. Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4.5 to 7.5 inches.

Kneeland loam has a profile similar to that of Kneeland loam, 5 to 9 percent slopes. Depth to sandstone is 25 to 40 inches. Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 7 inches.

These soils are used for range and pasture. Capability unit VIe-3; Kinman, range site 6; Kneeland, range site 12.

Kneeland Series

The Kneeland series consists of well-drained loams that have a clay loam subsoil. At a depth of 25 to 45 inches they are underlain by medium-grained, hard sandstone. These soils are on uplands. They are in the western and northwestern areas of the county near the Pacific Ocean from Bodega Bay to the Fort Ross vicinity. Slopes are 5 to 75 percent. Elevation ranges from 100 to 1,500 feet. Annual rainfall is 30 to 40 inches, annual temperature is 52° to 56° F., and the frost-free season is 280 to 310 days. The vegetation is chiefly annual and perennial grasses, brackenfern, forbs, and small brush. A few areas have scattered hardwoods, such as oak and California laurel. The Kneeland soils are associated with the Kinman, Los Osos, Rohnerville, and Steinbeck soils.

In a typical profile the surface layer is about 13 inches of dark grayish-brown, medium acid loam and about 5 inches of grayish-brown, medium acid clay loam. The subsoil is mottled pale-brown and brownish-yellow, medium acid clay loam. At a depth of about 35 inches is fractured and weathered sandstone (graywacke). The mottling in the subsoil is a result of differential weathering of parent material.

Kneeland soils are used mainly for range and pasture grazing by sheep and cattle. A few gently sloping areas are used for hay crops.

Kneeland loam, 5 to 9 percent slopes (KnC).--This gently sloping to moderately sloping soil is on upland ocean terraces.

Typical profile at an elevation of 525 feet; slope faces west-northwest; 2.8 miles north-northwest of Bedega Bay on Coleman Valley Road near Irish Hill (NE1/4 NW1/2 sec. 15, T. 6 N., R. 11 W.):

A1--0 to 13 inches, dark grayish-brown (2.5Y 4/2) loam, very dark gray (10YR 3/1) moist; moderate, fine and medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many, very fine and fine, tubular and interstitial pores; medium acid (pH 6.0); gradual, smooth boundary.

A3--13 to 18 inches, grayish-brown (2.5Y 5/2) clay loam, very dark grayish-brown (10YR 3/2) moist; weak, medium, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common, very fine, tubular pores; a few thin clay films in pores and on ped faces; medium acid (pH 6.0); clear, smooth boundary.

B2--18 to 35 inches, mottled, pale-brown (10YR 6/3), and brownish-yellow (10YR 6/6) clay loam, brown (10YR 5/3) moist; massive and weak, coarse, subangular blocky structure; hard, firm, slightly sticky and plastic; a few very fine roots; common, very fine, tubular and interstitial pores; common thin clay films in pores and on some ped faces; medium acid (pH 5.7); gradual, diffuse boundary.

R--35 inches, light yellowish-brown, fractured and weathered, medium-grained sandstone (graywacke).

The A horizon ranges in color from brown to dark grayish brown or grayish brown and from sandy loam to light clay loam. This horizon ranges from moderate, fine, granular structure to moderate, medium, subangular blocky structure. The A horizon is medium acid to strongly acid, and ranges in thickness from 10 to 20 inches. The B horizon ranges from pale brown to yellowish brown or brownish yellow in color, and from heavy loam to clay loam. The structure ranges from weak, fine, and granular to weak, coarse, and subangular blocky, or the soil is massive. This horizon is medium acid to strongly acid. It is from 15 to 25 inches thick. Occasionally, a layer of thin gravel or small rock fragments separates the A horizon from the B horizon. The R horizon is pale-brown to light yellowish-brown hard sandstone with streaks of weakly consolidated sandy clay loam.

Included in mapping are scattered areas of sandstone outcrops and small areas of Kinman loam and Steinbeck loam.

Permeability is moderate in the subsoil of this Kneeland soil. Runoff is slow, and the hazard of erosion is slight. Fertility is moderately low, and the available water capacity is 4 to 8 inches. The effective rooting depth is 25 to 45 inches.

This soil is used mainly for range and pasture. Some areas are used for growing potatoes, peas, beans, and other row crops. Capability unit IIIe-1; range site 12.

Kneeland loam, 9 to 15 percent slopes (KnD).--This soil is similar to Kneeland loam, 5 to 9 percent slopes, but it generally is about 25 to 40 inches deep. It is strongly sloping and occurs on terraces, typically on Pacific coastal formations.

Included in mapping are small areas of Kinman loam, Rohnerville loam, and Steinbeck loam.

Runoff is medium. The hazard of erosion is moderate.

This soil is used about the same as Kneeland loam, 5 to 9 percent slopes. Capability unit IVe-1; range site 12.

Kneeland loam, 15 to 30 percent slopes (KnE).--This soil is similar to Kneeland loam, 5 to 9 percent slopes, but it generally is about 25 inches deep, though it may reach a depth of 45 inches. This soil is moderately steep and in on hills.

Included in mapping are small areas of Kinman loam, Los Osos clay loam, and Steinbeck loam.

Runoff is medium to rapid. The hazard of erosion is moderate to high.

This soil is used mainly for range. Capability unit VIe-1; range site 12.

Kneeland loam, 30 to 50 percent slopes (KnF).--This soil is similar to Kneeland loam, 5 to 9 percent slopes. It generally is about 25 inches deep, but at times it is 40 inches deep.

Included in mapping are small areas of Kinman loam, Los Osos clay loam, and Steinbeck loam.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for range, for sheep grazing. Capability unit VIe-1; range site 12.

Kneeland rocky complex, 30 to 75 percent slopes (KoG).--Rock outcrops or "sea stacks," scattered throughout the fields, occupy about 15 to 20 percent of the surface area of this complex. Sea stacks are remnant, weather-resistant, fine-grained sandstone that rise above the surface. The remaining 80 to 85 percent of these areas consists of Kneeland loam. Occasionally there are stones in the subsoil. Runoff is very rapid, and the hazard of erosion is very high. Kneeland soils seldom exceed a depth of 24 inches, but in places are as deep as 40 inches.

Included in mapping are small areas of Kinman loam, Los Osos clay loam, and Steinbeck loam.

This complex is used mainly for grazing. Capability unit VIIe-1; range site 12.

Kneeland series, sandy variant

The Kneeland sandy variants consist of well-drained coarse sandy loams that are underlain, at a

depth of 15 to 36 inches by soft sandstone. These soils are on remnants of marine terraces. They are mainly in the southwestern part of the county, 8 to 10 miles inland, in the vicinity of Valley Ford along the northern side of the Estero Americano. Slopes are 2 to 30 percent. Elevation ranges from 50 to 400 feet. Annual rainfall is 20 to 35 inches, annual temperature is 54° to 56° F., and the frost-free season is 280 to 300 days. The vegetation is chiefly annual and perennial grasses, forbs, and shrubs. The Kneeland sandy variants are associated with the Goldridge, Kneeland, and Steinbeck soils.

In a typical profile the surface layer is brown, medium acid sandy loam and pale-brown, strongly acid coarse sandy loam about 18 inches thick. The next layer is mixed pale-brown and strong-brown, very strongly acid loamy coarse sand. At a depth of about 28 inches is mixed pale-brown and strong-brown, weakly consolidated weathered sandstone.

Kneeland sandy variants are used mainly for grazing by sheep and cattle. A few gently sloping areas are used for hay crops.

Kneeland sandy loam, sandy variant, 2 to 15 percent slopes (KsD).--Much of this soil is moderately sloping and is on the top of marine terraces. These terrace tops remained after runoff water during geologic time cut channels and long, nearly level valleys in the old landscape.

Typical profile in a native pasture in good condition; smooth, southeast-facing slope of 8 percent; on the Illia Ranch, 3,480 feet west and 950 feet north of the town of Valley Ford (SE1/4 NW1/4 sec. 35; T. 6 N., R. 10 W.); the profile was dry when examined:

A11--0 to 2 inches, brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, medium and fine, granular structure; slightly hard, friable, slightly sticky and nonplastic; many micro and very fine roots; many, very fine, interstitial pores; medium acid (pH 6.0); abrupt, wavy boundary.

A12--2 to 18 inches, pale-brown (10YR 6/3) coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, medium and fine, granular structure; slightly hard, very friable, slightly sticky and nonplastic; many micro and very fine roots; many, very fine, tubular and interstitial pores; strongly acid (pH 5.5); abrupt, irregular boundary.

C1--18 to 28 inches, mixed pale-brown (10YR 6/3) and strong-brown (7.5YR 5/6) loamy coarse sand; when moist, mixed dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/8); strong, very thick, platy structure; hard, firm, nonsticky and nonplastic; a few very fine roots; common, very fine, interstitial pores; many moderately thick clay films on ped faces; very strongly acid (pH 5.0); clear, wavy boundary.

C2--28 inches, mixed pale-brown (10YR 6/3) and strong-brown (7.5YR 5/6) weakly consolidated weathered sandstone that breaks down to loamy coarse sand; yellowish brown (10YR 5/6) moist; massive; extremely hard, very firm, nonsticky and nonplastic; strongly acid (pH 5.5).

The A horizon ranges from brown to pale brown in color and from coarse sandy loam to loam in texture. This horizon is massive or has moderately granular structure. The C horizon colors are generally mixed pale brown, light yellowish brown, yellowish brown, or strong brown. Reaction ranges from medium acid to very strongly acid and tends to increase with depth. In some areas the C horizon has thin layers of fine, polished gravel.

Included in mapping are small areas of Steinbeck loam and sandstone outcrops. Also included are areas 16 to 20 inches deep.

Permeability is moderately rapid in this Kneeland soil. Runoff is medium, and the hazard of erosion by water is moderate. The hazard of soil blowing is high. Fertility is moderate. The available water capacity is from 2 to 3.5 inches. The effective rooting depth is 20 to 36 inches.

This soil is used mainly for grazing by sheep and cattle. A few areas in the Coleman Valley vicinity and near Freestone are in stands of Douglas-fir of fair quality. These areas are located in areas of greater rainfall or increased ground water.

During past years the pasture areas have been used for growing corn, potatoes, peas, beans, and other row crops. Most of these areas are now used for pasture. Where water is available, a few fields on the lower slopes have been irrigated. Capability unit IVe-1; range site 12.

Kneeland sandy loam, sandy variant, 15 to 30 percent slopes (KsE).--This soil is similar to Kneeland sandy loam, sandy variant, 2 to 15 percent slopes, but it is 20 to 30 inches deep to the substratum.

Included in mapping are small areas of Kinman loam, Kneeland loam, and Steinbeck loam.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. The hazard of soil blowing is high. The available water capacity is 2 to 3 inches.

The main use of this soil is for pasture for sheep and cattle. It is also used for some family orchards. Capability unit VIe-4; range site 12.

Kneeland rocky sandy loam, sandy variant, 9 to 30 percent slopes (KvE).--This soil is somewhat shallower to the substratum than Kneeland sandy loam, sandy variant, 2 to 5 percent slopes. Depth to sandstone is 15 to 25 inches. The soil has steeper slopes. Rock outcrops, called sea stacks, cover about 2 to 10 percent of the surface.

Included in mapping are small areas of Kinman loam, Los Osos clay loam, and Steinbeck loam.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. The hazard of soil blowing is high. The available water capacity is 2 to 3 inches.

This soil is used mainly for grazing by sheep. Capability unit VIe-4; range site 12.

Laniger Series

The Laniger series consists of well-drained loams. The soils are underlain, at a depth of 18 to 45 inches, by weathered rhyolite and rhyolitic tuff. These soils are on mountainous uplands. They are mainly in the southeastern part of the county and in the hills in the east-central area. Slopes are 5 to 50 percent. Elevation ranges from 600 to 2,000 feet. Annual rainfall is 30 to 60 inches, annual temperature is 60° to 62° F., and the frost-free season is 250 to 275 days. In most places the vegetation is oak and madrone trees, manzanita, and sparse stands of grass, but there are a few areas of Douglas-fir and redwood. The Laniger soils are associated with the Forward, Kidd, and Spreckels soils.

In a typical profile the surface layer is grayish-brown, strongly acid and medium acid loam about 17 inches thick. The subsoil is grayish-brown, medium acid loam about 12 inches thick. Rhyolite rock mixed with brown sandy loam occurs at a depth of 29 inches.

Laniger soils are used for range and grazing by sheep and cattle. A few small areas supporting conifers are used for the production of lumber.

Laniger loam, 9 to 15 percent slopes (LaD).--This strongly sloping soil is on uplands.

Typical profile in a pasture in fair condition; southwest-facing slope of 10 percent; about 2 miles northeast from the Old Adobe monument (NE1/4 SE1/4 sec. 18, T. 5 N., R. 6 W.); the profile was moist at a depth of 20 inches and below when examined:

A11--0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, granular structure; hard, friable, nonsticky and slightly plastic; many very fine roots; common, very fine, tubular pores; strongly acid (pH 5.5); clear, smooth boundary.

A12--6 to 17 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; moderate, medium, granular structure; slightly hard, friable, nonsticky and slightly plastic; common very fine and fine roots and many medium and coarse roots; many, very fine, tubular and interstitial pores; medium acid (pH 6.0); clear, smooth boundary.

B2--17 to 29 inches, grayish-brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; moderate, medium, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many, very fine and fine, tubular and interstitial pores; medium acid (pH 6.0); gradual, smooth boundary.

C&R--29 to 41 inches, fractured rhyolite; brown (10YR 5/3) sandy loam in cracks, dark yellowish brown (10YR 3/4) moist; massive; very hard, firm, nonsticky and slightly plastic; a few very fine and fine roots along the cracks in bedrock; common moderately thick clay films along the cracks; medium acid (pH 6.0).

The A horizon ranges from brown to pale-brown in color and from sandy loam to light clay loam in texture. Some areas, generally supporting stands of oak and located in swales and draws on hillside locations, have an accumulation of grayish-brown clay in the B horizon. Depth to rhyolite or rhyolitic tuff varies from 25 to 45 inches.

Included in mapping are small areas of Forward gravelly loam, Kidd stony loam, and Spreckels loam.

Permeability is moderate in the subsoil of this Laniger soil. Runoff is medium, and the hazard of erosion is moderate. Fertility is moderate. The available water capacity is 5 to 7 inches.

The main use of this soil is for range and pasture. Capability unit IVe-1; range site 4.

Laniger loam, 5 to 9 percent slopes (LaC).--Depth of this Laniger loam averages about 40 inches, although it may be shallow as 30 inches or as deep as 45 inches. In other respects it is similar to Laniger loam, 9 to 15 percent slopes.

Included in mapping are small areas of Forward gravelly loam and Spreckels loam.

Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for pasture, but some areas have been used for growing oats and vetch for hay. Capability unit IIIe-1.

Laniger loam, 15 to 30 percent slopes (LaE).--This soil is very much like Laniger loam, 9 to 15 percent slopes, except that it is only 24 to 30 inches deep.

Included in mapping are small areas of Forward gravelly loam and Spreckels loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is approximately 4 to 5.5 inches.

This soil is used mainly for pasture and range. Capability unit VIe-1; range site 4.

Laniger loam, 15 to 30 percent slopes, eroded (LaE2).--This soil is similar to Laniger loam, 9 to 15 percent slopes, but depth to rhyolite or rhyolitic tuff ranges from 18 to 25 inches. It is steeper, and overuse has caused soil loss through erosion.

Included in mapping are small areas of Forward gravelly loam, Kidd gravelly loam, and Spreckels loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 3 to 4 inches.

The primary use of this soil is for pasture and range. Capability unit VIe-1; range site 4.

Laniger loam, 30 to 50 percent slopes (LaF).--This soil is similar to Laniger loam, 9 to 15 percent slopes. It is approximately 20 to 30 inches deep and tends to be droughty. Most of this soil is underlain by hard rhyolite rock. A few areas have scattered rock outcrop and stones in the surface layers.

Included in mapping are small areas of Forward gravelly loam, Kidd stony loam, and Spreckels loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 5.5 inches.

The primary use of this soil is for range. Capability unit VIe-1; range site 8.

Laughlin Series

The Laughlin series consists of well-drained loams that have a sandy clay loam subsoil. At a depth of 14 to 36 inches the soils are underlain by fine-grained sandstone and shale. These soils are on mountainous uplands and ridgetops. They are mainly across the northern half of the county. Slopes are 2 to 75 percent. Elevation ranges from 800 to 3,000 feet. Annual rainfall is 25 to 70 inches, annual temperature is 52° to 56° F., and the frost-free season is 240 to 260 days. The vegetation is chiefly annual and perennial grasses, forbs, and small shrubs, or a combination of oak-grass and manzanita. The Laughlin soils are associated with the Hugo, Maymen, Suther, and Yorkville soils.

In a typical profile the surface layer is brown, medium acid loam about 4 inches thick. The subsoil is brown, strongly acid sandy clay loam about 18 inches thick. Fractured and weathered sandstone and shale occur at a depth of about 22 inches.

Laughlin soils are used mainly for range and for grazing by sheep and cattle. A few of the lower slope areas are used for such crops as hay, oats, or oats and vetch.

Laughlin loam, 50 to 75 percent slopes (LgG).--This soil is on very steep mountainous terrain of the Coast Range.

Typical profile 2 miles south-southwest of Hedgpeth Lake (NE1/4 NW1/4 sec. 28, T. 9 N., R. 12 W.); the profile was dry when examined:

A1--0 to 4 inches, brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable, nonsticky and slightly plastic; many very fine and fine roots; many, very fine and fine, tubular and interstitial pores; medium acid (pH 5.7); clear, smooth boundary.

B2--4 to 22 inches, brown (10YR 5/3) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; hard, friable, nonsticky and slightly plastic; many very fine and fine roots; common, very fine and fine, tubular and interstitial pores; strongly acid (pH 5.5); clear, irregular boundary.

R--22 inches, yellowish-brown sandstone and shale, dark grayish brown (2.5Y 4/2) moist; a few thin patchy clay films along rock fractures.

The A horizon ranges from grayish-brown to brown in color and from nongravelly to gravelly loam and clay loam. Gravel content ranges from none to 20 percent, by volume. The B horizon ranges from pale brown or brown to light yellowish brown or yellowish brown in color. Depth to sandstone or shale is between 20 and 30 inches.

Included in mapping are small areas of Hugo very gravelly loam, Maymen gravelly sandy loam, Suther loam, and Yorkville clay loam. Also included are areas with a pale brown loam surface layer.

Permeability is moderate in the subsoil of this Laughlin soil. Runoff is very rapid, and the hazard of erosion is very high. Fertility is moderately low. The available water capacity is about 3 to 4.5 inches.

This soil is used mainly for range. Capability unit VIIe-8; range site 8.

Laughlin loam, 2 to 30 percent slopes (LgE).--This soil is similar to Laughlin loam, 50 to 75 percent slopes, but it is 20 to 36 inches deep.

Included in mapping are small areas of Hugo very gravelly loam, Suther loam, and Yorkville clay loam.

Runoff is slow to rapid, and the hazard of erosion is slight to high. Fertility is moderate. The available water capacity is about 3 to 5.5 inches.

This soil is used mainly for range. Some small areas are used for oat and vetch hay. Capability unit IVe-8; range site 4.

Laughlin loam, 30 to 50 percent slopes (LgF).--This soil is similar to Laughlin loam, 50 to 75 percent slopes.

Included in mapping are small areas of Hugo very gravelly loam, Maymen gravelly sandy loam, and Suther loam.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for range. Capability unit VIe-8; range site 4.

Laughlin loam, 50 to 75 percent slopes, eroded (LgG2).--This soil is similar to Laughlin loam, 50 to 75 percent slopes, but the surface layer is eroded. Depth to bedrock is 14 to 18 inches.

Included in mapping are small areas of Hugo very gravelly loam, Maymen gravelly sandy loam, and Suther loam. Also included are scattered areas of shale outcrops.

The available water capacity is 2 to 3 inches.

This soil is used mainly for range. Capability unit VIIe-8; range site 8.

Laughlin-Yorkville complex, 30 to 75 percent slopes (LhG).--This complex is scattered across half of the county, and a small acreage is on the coastal area south of Jenner. Laughlin soils make up about 70 percent of the complex, and Yorkville soils about 30 percent. In a few areas the soil is eroded. Rock outcrops are more often found on the Laughlin soils, and landslips are common on the Yorkville soils.

The Laughlin soils have a profile similar to that of Laughlin loam, 50 to 75 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is 3 to 4 inches. The effective depth of rooting is 20 to 30 inches.

The Yorkville soils have a profile similar to that of Yorkville clay loam, 5 to 30 percent slopes. Runoff is rapid to very rapid and the hazard of erosion is high to very high.

The main use of these soils is for range. Capability unit VIIe-8; Laughlin, range site 8; Yorkville, range site 6.

Los Gatos Series

The Los Gatos series consists of well-drained loams. The soils are underlain, at a depth of 24 to 48 inches, by weathered sandstone and shale. These soils are on mountainous uplands. They are mainly in the north central part of the county to the west and north of Healdsburg. Slopes are 30 to 75 percent. Elevation ranges from 800 to 3,000 feet. Annual rainfall is 25 to 70 inches, annual temperature is 52° to 56° F., and the frost-free season is 240 to 260 days. In most places the vegetation is chiefly brush and hardwood, such as manzanita, poison oak, black oak, and white oak, and sparse stands of grass. A few areas, however, have scattered Douglas-fir trees. The Los Gatos soils are associated with the Boomer, Hugo, Josephine, and Maymen soils.

In a typical profile the surface layer is grayish-brown and brown, slightly acid loam about 7 inches thick. This layer is covered with a thin layer of manzanita leaves and twigs about 1 inch thick. The subsoil is light reddish-brown, slightly acid heavy loam and pink, medium acid gravelly light clay loam. It is about 18 inches thick. At a depth of about 25 inches is strongly weathered sandstone and shale.

Los Gatos soils are used mainly for range for livestock and wildlife and as watershed.

Los Gatos loam, 30 to 75 percent slopes (LkG).--This steep to very steep soil is on uplands.

Typical profile on a convex hillside; west-facing slope of 50 percent; 2.66 miles west of Daniels School on Mill Creek Road (SW1/4 NE1/4 sec. 26, T. 9 N., R. 11 W.):

O1--1 inch to 0, duff layer of manzanita leaves and twigs.

A11--0 to 2 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure; slightly hard, friable, nonsticky and slightly plastic; a few very fine and fine roots; many, very fine, tubular pores and common, fine, interstitial pores; slightly acid (pH 6.5); 10 percent gravel; clear, smooth boundary.

A12--2 to 7 inches, brown (7.5YR 5/4) loam, dark reddish brown (5YR 3/3) moist; weak, medium, granular structure; hard, friable, nonsticky and slightly plastic; a few very fine and fine roots and many medium and coarse roots; many very fine tubular pores and a few, medium, tubular pores; slightly acid (pH 6.3); 10 percent gravel; gradual, smooth boundary.

B1--7 to 17 inches, light reddish-brown (5YR 6/4) heavy loam, reddish brown (5YR 4/4) moist; massive; hard, friable, nonsticky and slightly plastic; a few very fine roots and common medium and coarse roots; common medium and many, very fine, tubular pores; a few thin clay films in pores; slightly acid (pH 6.3); 15 percent gravel; gradual, smooth boundary.

B2t--17 to 25 inches, pink (7.5YR 7/4) gravelly light clay loam, yellowish red (5YR 5/6) moist; massive; hard, friable, sticky and slightly plastic; a few very fine coarse and medium roots; many, very fine, tubular pores; many thin clay films in pores; medium acid (pH 6.0); 35 percent gravel; gradual, smooth boundary.

R--25 inches, strongly weathered sandstone and shale; massive; a few very fine, fine, and coarse roots in cracks; common thin clay films on fractures along rock faces.

The A horizon ranges from grayish-brown to reddish-brown in color. It is neutral to slightly acid and contains 5 to 15 percent gravel. The Bt horizon contains 20 to 35 percent gravel. The depth to sandstone and shale is 24 to 48 inches.

Included in mapping are small areas of Boomer loam, Hugo very gravelly loam, Josephine loam, and Maymen gravelly sandy loam. Also included are areas of soil that has slopes of less than 30 percent.

Permeability is moderately slow in the subsoil of this Los Gatos soil. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Fertility is very low. The available water capacity is 4 to 8 inches.

This soil is used mainly for watershed and for range for livestock and wildlife. Capability unit VIIe-8; range site 10.

Los Gatos gravelly loam, 30 to 75 percent slopes (LmG).--This soil is similar to Los Gatos loam, 30 to 75 percent slopes, but contains 15 to 35 percent gravel, by volume, throughout the soil profile.

Included in mapping are small areas of Boomer loam, Hugo very gravelly loam, and Maymen gravelly sandy loam.

The available water capacity is 3 to 6 inches.

This soil is used mainly for watershed and for range for livestock and wildlife. Capability unit VIIe-8; range site 10.

Los Gatos-Josephine complex, 30 to 75 percent slopes (LnG).--This complex is mostly on very steep slopes, but there are also small areas on less steeper slopes. Los Gatos gravelly loam makes up about 75 percent of the complex, and Josephine loam about 25 percent. In most places the cover is chiefly thick stands of brush and scattered oak trees with an understory of annual grasses and forbs. Small mixed stands of hardwood and conifers are in areas where the soil is deepest. In recent years, much of the area has been burned. In places soil loss has resulted from the action of winter storms.

Los Gatos gravelly loam has a profile similar to that of Los Gatos loam, 30 to 75 percent slopes, but it contains 15 to 35 percent gravel throughout the profile. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Depth to rock ranges from 24 to 48 inches. The available water capacity is 3 to 6 inches.

The Josephine loam has a profile similar to that of Josephine loam, 50 to 75 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

Soils in this complex are used mainly for range. Capability unit VIIe-8; range site 10.

Los Osos Series

The Los Osos series consists of well drained clay loams that have a clay subsoil. At a depth of 15 to 50 inches the soils are underlain by weathered, fractured sandstone and shale. These soils are on rolling hills and mountainous uplands. They are mainly in the south-central part of the county, west of Petaluma along the boundary between Sonoma and Marin Counties. Slopes are 2 to 50 percent. Elevation ranges from 500 to 1,200 feet. Annual rainfall is 20 to 35 inches, annual temperature is between 58° and 60° F., and the frost-free season is 260 to 290 days. In most places the vegetation is chiefly annual and perennial grasses, forbs, and scattered oak trees. Some areas, particularly those on steep northerly slopes, have a cover of other types of hardwoods or small shrubs. The Los Osos soils are associated with the Goldridge, Pajaro, and Steinbeck soils.

In a typical profile the surface layer is grayish-brown, medium acid clay loam about 6 inches thick. The subsoil is grayish-brown and light olive-brown, medium acid and neutral clay loam and clay. At a depth of about 34 inches is weathered sandstone.

Los Osos soils are used mainly for grazing by sheep and cattle. A few areas on the lower slopes and ridgetops are used for the production of hay.

Los Osos clay loam, 15 to 30 percent slopes (LoE).--This moderately steep soil is on rolling uplands. Most slopes are 22 to 30 percent.

Typical profile 2.5 miles south of Petaluma in a grazed pasture; slightly convex southeasterly slope of 18 percent; 800 feet due west of a gate opening from "I" Street extension and 1,200 feet northwest of the junction of "I" Street extension and San Antonio Road (NE1/4 SW1/4 sec. 16, T. 4 N., R. 7 W.); the profile was slightly moist below a depth of 16 inches when examined:

A1--0 to 6 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; medium acid (pH 6.0); clear, smooth boundary.

B1--6 to 16 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine pores; thin continuous clay films in pores; medium acid (pH 6.0); clear, smooth boundary.

B21t--16 to 28 inches, grayish-brown (2.5Y 5/3) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, sticky and plastic; a few very fine roots; common very fine pores; moderately thick clay films in pores; neutral (pH 7.0); gradual, smooth boundary.

B22t--28 to 34 inches, light olive-brown (2.5Y 5/4) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, sticky and plastic; a few very fine roots; a few very fine pores; moderately thick clay films in pores; neutral (pH 7.0); abrupt, smooth boundary.

R--34 inches, light olive-brown (2.5Y 5/4), strongly weathered, fractured sandstone that has dark yellowish-brown (10YR 4/4) coatings.

The A horizon ranges from fine sandy loam to silty clay loam. The color of the A horizon varies from dark brown to grayish-brown, depending upon the amount of rainfall and the variations in parent material. Soil depth varies from 30 to 50 inches. Lower slopes tend to be deeper and have a thicker clay B horizon than upper slopes. Typically, the reaction becomes less acid with depth. Generally, the B and CR horizons are noncalcareous, although a few thin calcareous seams are in the parent material in places.

Included in mapping are small areas of Goldridge fine sandy loam, Pajaro fine sandy loam, and Steinbeck loam. Also included are scattered areas of craggy hard sandstone outcrops. Locally, these outcrops are called "sea stacks." Also included are areas that have a dark-gray clay surface layer.

Permeability is slow in the subsoil of this Los Osos soil. Runoff is medium to rapid, and the hazard of erosion is moderate to high. This soil is subject to landslips. Fertility is moderately high. The available water capacity is 5 to 8 inches. The effective rooting depth is 30 to 50 inches.

This soil is used mainly for pasture or range. Many large dairies are located in areas where this soil is prevalent. Capability unit IVe-3; range site 1.

Los Osos clay loam, 2 to 15 percent slopes (LoD).--This soil is similar to Los Osos clay loam, 15 to 30 percent slopes. Mapped areas are on ridgetops and lower foot slopes. Depth to the clay subsoil averages 24 inches, and depth to rock is 30 to 50 inches. Some small areas have surface textures of loam to light clay loam.

Included in mapping are small areas of Pajaro fine sandy loam and Steinbeck loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 5 to 8 inches.

This soil is used mainly for range. Some areas are used for producing oats and vetch for hay. Fields are irrigated where water is available. Capability unit IIIe-3; range site 1.

Los Osos clay loam, 30 to 50 percent slopes (LoF).--This soil is similar to Los Osos clay loam, 15 to 30 percent, but it is generally 30 to 36 inches thick. Scattered outcrops of sandstone and shale, covering less than 3 percent of the surface, are on the upper slopes.

Included in mapping are small areas of Goldridge fine sandy loam and Steinbeck loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 5 to 6 inches.

This soil is used mainly for range. Capability unit VIe-3; range site 1.

Los Osos clay loam, 30 to 50 percent slopes, eroded (LoF2).--This soil is similar to Los Osos clay loam, 15 to 30 percent slopes. Sheet and gully erosion has resulted from overuse of this soil, however, mainly by grazing sheep. Natural slippage is evident and occasionally there are stabilized slips. This soil is 24 to 28 inches deep.

Included in mapping are small areas of Goldridge fine sandy loam and Steinbeck loam. Also included are areas with rock outcrops covering up to 10 percent of the surface.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 5 inches.

This soil is used mainly for range. Capability unit VIe-3; range site 1.

Los Osos clay loam, thin solum, 5 to 15 percent slopes (LsD).--This soil is similar to Los Osos clay loam, 15 to 30 percent slopes, but the solum is 21 to 30 inches thick. The surface layer is thinner and the subsoil is light brown. This soil is strongly sloping rather than moderately steep.

Included in mapping are small areas of Goldridge fine sandy loam, Pajaro fine sandy loam, and Steinbeck loam. Also included are scattered outcrops of hard sandstone.

Runoff is medium, and the hazard of erosion is moderate. Fertility is moderate. The available water capacity is 3.5 to 5 inches.

This soil is used mainly for range. Capability unit IVe-3; range site 4.

Los Osos clay loam, thin solum, 15 to 30 percent slopes (LsE).--This soil is similar to Los Osos clay loam, 15 to 30 percent slopes, but the surface layer is 10 to 12 inches thick, and the depth to parent material is 20 to 25 inches.

Included in mapping are small areas of Goldridge fine sandy loam and Steinbeck loam. Also included are scattered outcrops of hard sandstone.

Fertility is moderate. The available water capacity is 3 to 4 inches.

This soil is used mainly for range. Capability unit VIe-3; range site 4.

Los Osos clay loam, thin solum, 15 to 30 percent slopes, eroded (LsE2).--This soil is somewhat shallower than Los Osos clay loam, 15 to 30 percent slopes. Depth to parent material is only 16 to 24 inches. Sheet and gully erosion has resulted from overuse. Surface layers are 3 to 6 inches thinner.

Included in mapping are small areas of Goldridge fine sandy loam and Steinbeck loam. Also included are scattered outcrops of hard sandstone.

Fertility is moderate. The available water capacity is about 2 to 4 inches.

This soil is used mainly for range. Capability unit VIe-3; range site 4.

Los Osos clay loam, thin solum, 30 to 50 percent slopes, eroded (LsF2).--This soil is shallower than Los Osos clay loam, 15 to 30 percent slopes. Depth to parent material is only 15 to 22 inches. Surface layers are only 3 to 6 inches thick. Occasionally there are places where the subsoil is exposed. Sheet erosion and gully erosion have resulted from overuse. Landslips are numerous on the steep slopes.

Included in mapping are small areas of Goldridge fine sandy loam and Steinbeck loam. Also included are areas with up to 10 percent rock outcrops on the surface.

Runoff is rapid, and the hazard of erosion is high. Fertility is moderate. The available water capacity is 2.5 to 4 inches.

This soil is used mainly for range. Capability unit VIIe-3; range site 8.

Los Robles Series

The Los Robles series consists of moderately well-drained gravelly clay loams that have a gravelly sandy clay loam subsoil. The soils are underlain by predominantly basic igneous alluvium of mixed gravel, stones, rock fragments, and clay. These soils are on alluvial fans and plains. They generally are in the central and southern areas of Sonoma Valley. Slopes are 0 to 5 percent. Elevation ranges from 200 to 500 feet. Annual rainfall is 25 to 35 inches, annual temperature is 60° to 62° F., and the frost-free season is 220 to 245 days. In uncultivated areas the vegetation is mixed grasses, forbs, small shrubs, and scattered oak trees. Nearly all areas have been cleared, however, and are cultivated. The Los Robles soils are associated with the Manzanita, Tuscan, and Zamora soils.

In a typical profile the surface layer is dark-brown, very dark grayish-brown, and dark grayish-brown, slightly acid gravelly clay loam about 37 inches thick. The subsoil is brown gravelly clay loam and gravelly sandy clay loam. It is medium acid and slightly acid. At a depth of about 60 inches is the substratum of grayish-brown very gravelly sandy clay.

The Los Robles soils are used for fruit and nut orchards, vineyards, and for producing hay. Some irrigated areas are used for pasture.

Los Robles gravelly clay loam, 0 to 2 percent slopes (LuA).--This nearly level soil is on low flood plains.

Typical profile in a prune orchard in good condition in the Sonoma Valley; slope of 1 percent; 100 feet northwest of Frey Road and 1,000 feet southwest of California Highway No. 12, (NW1/4 NW1/4 sec. 30, T. 7 N., R. 6 W.); the profile was moist when examined:

Ap--0 to 6 inches, dark-brown (10YR 3/3) gravelly clay loam, very dark brown (10YR 2/2) moist; moderate and strong, medium, granular structure; soft, very friable, sticky and slightly plastic; many very fine roots; intense worm activity; slightly acid (pH 6.5); abrupt, wavy boundary.

A11--6 to 15 inches, very dark grayish-brown (10YR 3/2) gravelly clay loam, very dark brown (10YR 2/2) moist; massive; slightly hard, firm, sticky and plastic; many very fine roots; common, very fine and fine, interstitial pores; continuous thin clay films in pores and on mineral grains; compaction from cultivation causes brittleness in places; slightly acid (pH 6.5); clear, wavy boundary.

A12--15 to 37 inches, dark grayish-brown (10YR 4/2) gravelly clay loam, very dark brown (10YR 2/2) moist; massive; soft, very friable, sticky and plastic; a few medium roots and common very fine and fine roots; many, fine and medium, tubular and interstitial pores; continuous thin clay films in pores and on mineral grains; worm activity present; slightly acid (pH 6.5); clear, wavy boundary.

B21t--37 to 50 inches, brown (10YR 4/3) gravelly clay loam, dark brown (10YR 3/3) moist; massive; soft, friable, sticky and plastic; common fine roots; a few, medium, tubular pores and common, fine, tubular and interstitial pores; continuous thin clay films in pores and on mineral grains; medium acid (pH 6.0); clear, irregular boundary.

B22t--50 to 60 inches, brown (10YR 4/3) gravelly sandy clay loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, sticky and plastic; a few fine roots and a few very fine roots; many, very fine, tubular and interstitial pores; continuous thin clay films in pores; slightly acid (pH 6.5); abrupt, wavy boundary.

IIC--60 to 72 inches, grayish-brown (10YR 5/2) very gravelly sandy clay, dark brown (7.5YR 3/2) moist; massive; slightly hard, friable, slightly sticky and plastic; a few fine roots; 95 percent gravel by volume, including some cobblestones.

The A horizon ranges in color from brown to very dark brown and from grayish brown to very dark grayish brown. This layer is generally slightly acid to neutral. Gravel content ranges from 15 to 35 percent, by volume, generally increasing with depth. The IIC horizon occurs at depths of 45 to 60 inches.

Included in mapping are small areas of Manzanita gravelly silt loam, Tuscan cobbly clay loam, and Zamora silty clay loam. Also included are small areas that are gravel-free, and some small areas with slopes greater than 2 percent.

Permeability is moderately slow in the subsoil of this Los Robles soil. Runoff is very slow, and the hazard of erosion is none to slight. The available water capacity is 7 to 8.5 inches. Fertility is high.

This soil is used mainly for the production of pears, prunes, grapes, walnuts, oats and hay, irrigated pasture, and dryland pasture. Capability unit IIs-4.

Los Robles gravelly clay loam, moderately deep, 0 to 5 percent slopes (LvB).--This soil is similar to Los Robles gravelly clay loam, 0 to 2 percent slopes. It is underlain, at a depth of 36 to 48 inches, however, by layers of coarse gravel, stones, and cobblestones.

Included in mapping are small areas of Tuscan cobbly clay loam and Zamora silty clay loam. Also included are small areas of Los Robles gravelly clay loam, 0 to 2 percent slopes.

Runoff is slow, and the hazard of erosion is slight. The available water capacity is 5.5 to 8 inches.

This soil is used mainly for vineyards. Some areas are used for orchards and irrigated and dryland pastures. Capability unit IIe-1.

Manzanita Series

The Manzanita series consists of moderately well-drained gravelly silt loams that have a heavy clay loam subsoil. These soils formed in alluvium derived dominantly from basic igneous rock sources. They are on alluvial fans and river terraces, mainly on the east side of Dry Creek Valley and in the vicinity of Rincon Valley east of Santa Rosa. Slopes are 0 to 9 percent. Elevation ranges from 300 to 700 feet. Annual rainfall is 25 to 45 inches, annual temperature is 52° to 54° F., and the frost-free season is 230 to 250 days. Where not cultivated, the vegetation is chiefly annual and perennial grasses, forbs, small shrubs, and scattered oak trees. Wild berry vines grow along stream channels. The Manzanita soils are associated with the Haire, Yolo, and Zamora soils.

In a typical profile the surface layer is brown, medium acid gravelly silt loam about 4 inches thick. The subsoil is reddish-brown and dark reddish-gray, medium acid heavy clay loam and gravelly heavy clay loam. At a depth of about 47 inches is reddish-brown, medium acid clay loam that extends to a depth of more than 60 inches.

Manzanita soils are used mainly for the production of prunes, walnuts, and grapes. Some irrigated areas are used for growing hay or for pasture.

Manzanita gravelly silt loam, 0 to 9 percent slopes (MbC).--This soil is on low terraces. Most

of the slopes are long, smooth, and sometimes gently undulating. This soil is mostly gently sloping, but it is level and nearly level on a few acres.

Typical profile in a prune orchard in good condition; slope of 2 percent; at the Fellone ranch, West Side Road, .75 mile south of Yokum Bridge (NE1/4 SW1/4 sec. 27, T. 10 N., R. 10 W.); the profile was slightly moist above a depth of 12 inches and moist below this depth when examined:

Ap--0 to 4 inches, brown (7.5YR 5/4) gravelly silt loam, dark reddish brown (5YR 3/4) moist; cloddy; hard, friable, slightly sticky and slightly plastic; common very fine roots; medium acid (pH 6.0); abrupt, smooth boundary.

B21t--4 to 12 inches, reddish-brown (5YR 4/4) heavy clay loam, dark reddish brown (5YR 3/4) moist; weak, coarse, and very coarse, subangular blocky structure; extremely hard, firm, sticky and plastic; common coarse roots and many very fine and fine roots; many, very fine and fine, tubular pores; common thin clay films in pores and as bridges; medium acid (pH 6.0) many worm casts; clear, wavy boundary.

B22t--12 to 29 inches, dark reddish-gray (5YR 4/2) heavy clay loam, dark reddish brown (5YR 3/3) moist; weak, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine, fine, medium, and coarse roots; many, very fine and fine, tubular pores; common thin clay films in pores and as bridges; medium acid (pH 6.0); intense worm activity; a few krotovinas; gradual, wavy boundary.

B23t--29 to 47 inches, reddish-brown (5YR 4/3) gravelly heavy clay loam, dark reddish brown (5YR 3/3) moist; weak, medium and coarse, subangular blocky structure; slightly hard, friable, sticky and plastic; common micro and very fine roots; many, very fine and fine, tubular pores; common thin clay films in pores and as bridges; medium acid (pH 6.0); common worm casts; clear, wavy boundary.

C--47 to 66 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak, medium and coarse, subangular blocky structure; hard, friable, sticky and plastic; common micro and very fine roots; many, very fine and fine, tubular pores; common thin clay films in pores and as bridges; medium acid (pH 5.7); common worm casts.

The A horizon ranges in color from brown to dark brown when dry and from reddish brown to dark reddish brown when moist. The B horizon ranges in color from dark reddish brown to reddish gray and yellowish red. Gravel content varies from 5 to 25 percent, by volume, throughout the profile. Worm activity is common but varies in intensity.

Included in mapping are small areas of Haire gravelly sandy loam, Yolo gravelly loam, Yolo silt loam, and Zamora silty clay loam. Also included are areas of soil that has a very gravelly or very cobbly substratum at a depth of 48 inches or more.

Permeability is moderately slow in the subsoil of this Manzanita soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is high. The available water capacity is 10 to 12 inches.

These soils are widely used for vineyards and orchards. Some areas are also used for irrigated and dry pastures. Capability unit IIe-1.

Maymen Series

The Maymen series consists of well-drained gravelly sandy loams. They are underlain, at a depth of 10 to 20 inches, by sandstone and shale bedrock. These soils are on mountainous uplands, mainly in the northern third of the county. Scattered areas of this soil also are in the eastern part of the county. Slopes are 30 to 75 percent. Elevation ranges from 800 to 3,500 feet. Annual rainfall is 30 to 60 inches, annual temperature is 52° to 56° F., and the frost-free season is 240 to 260 days. In most places the vegetation is chiefly shrubs such as manzanita, chamise, and ceanothus. A few areas, however, have scattered clumps of scrub oak with a sparse understory of annual grasses and forbs. The Maymen soils are associated with the Henneke, Hugo, Huse, and Los Gatos soils.

In a typical profile the surface layer is pale-brown and light yellowish-brown, medium acid gravelly sandy loam about 12 inches thick. The subsoil is pale-brown, strongly acid gravelly loam. Weathered and fractured sandstone and shale occur at a depth of about 18 inches.

Maymen soils are used mainly for watershed and recreation and as wildlife habitat. Some grasses are produced on the lesser slopes in the spring. These areas are used for limited grazing.

Maymen gravelly sandy loam, 30 to 50 percent slopes (McF).--This steep soil is on mountainous uplands.

Typical profile 2.75 miles west of Daniels School on Mill Creek Road (NE1/4 SW1/4 sec. 26, T. 9 N., R. 11 W.):

A11--0 to 5 inches, pale-brown (10YR 6/3) gravelly sandy loam, brown (10YR 5/3) moist; massive; hard, friable, nonsticky and nonplastic; common very fine roots; many, very fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary.

A12--5 to 12 inches, light yellowish-brown (10YR 6/4) gravelly sandy loam, yellowish brown (10YR 5/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; a few very fine roots; many, very fine, tubular pores; medium acid (pH 5.8); clear, smooth boundary.

B2--12 to 18 inches, pale-brown (10YR 6/3) gravelly loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; a few very fine and fine roots; many, very fine, tubular and interstitial pores; strongly acid (pH 5.5); gradual boundary.

R--18 inches, fractured and weathered sandstone and shale; a few fine roots and common thin clay films on rock faces.

The A horizon ranges in color from very pale brown to brown or from yellowish brown to light yellowish brown. This horizon ranges from gravelly sandy loam to gravelly clay loam. The profile contains approximately 10 to 25 percent gravel, by volume, throughout. Depth to sandstone varies from 10 to 20 inches.

Included in mapping are small areas of Henneke gravelly loam, Hugo very gravelly loam, Huse stony clay loam, and Los Gatos gravelly loam. Also included are some areas where slope is 75 percent, some eroded areas, and areas that have as much as 10 percent rock outcrop.

Permeability is moderate in the subsoil of this Maymen soil. Runoff is rapid, and the hazard of erosion is high. Fertility is very low. The available water capacity is 1 to 2 inches.

This soil is used mainly for watershed, for wildlife browse and cover, and for limited range. Capability unit VIIe-8; range site 10.

Maymen-Los Gatos complex, 30 to 75 percent slopes (MlG).--This complex is in the northern half of the county and in the central-eastern part of the county along the Sonoma-Napa County line. Maymen soils make up about 50 percent of the complex, and Los Gatos soils about 50 percent. Maymen soils dominate the steeper slopes and Los Gatos soils dominate the lesser slopes. The vegetation is chiefly shrub with a few scattered oak trees on the Los Gatos soils.

The Maymen soils have a profile similar to that of Maymen gravelly sandy loam, 30 to 50 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Fertility is very low.

The Los Gatos soils have a profile similar to that of Los Gatos loam, 30 to 75 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Fertility is very low.

These soils are used mainly for watershed and as wildlife habitat. There is a limited amount of forage and browse on the lesser slopes of the deeper Los Gatos soils. Capability unit VIIe-8; range site 10.

Mendocino Series

The Mendocino series consists of moderately well-drained sandy clay loams that have a sandy clay subsoil. At a depth of 30 to 60 inches the soils are underlain by strongly weathered, coarse-grained sandstone and shale. These soils are on ridgetops and mountainous uplands. They are mainly in the northwestern third of the county near the ocean coastal areas. Slopes are 0 to 50 percent. Elevation ranges from 300 to 1,500 feet. Annual rainfall is 40 to 65 inches, annual temperature is between 52° and 56° F., and the frost-free season is about 285 to 310 days. The vegetation is chiefly Douglas-fir, redwood, tanoak, and madrone with brush and fern understory. The Mendocino soils are associated with the Caspar, Empire, Goldridge, and Hugo soils.

In a typical profile the surface layer is light yellowish-brown, yellowish-brown, and yellow, slightly acid and medium acid sandy clay loam about 26 inches thick. This layer is covered with a thin layer of fine duff, humus, and worm casts. The subsoil is yellowish-brown, strongly acid sandy clay about 28 inches thick. Strongly weathered sandstone and shale are at a depth of about 54 inches.

Mendocino soils are used mainly for the commercial production of Douglas-fir and redwood timber. A few cleared areas are being used for dryland pasture and small fruit orchards. Cleared areas on lesser slopes have been used for limited grazing.

Mendocino sandy clay loam, 9 to 30 percent slopes (MmE).--This moderately steep soil is on mountainous uplands. Most of the slopes are smooth and, in some places, rolling.

Typical profile in a selectively logged area in good condition; north-northeast facing slope of 10 percent, about 2 miles northeast of Stewart's Point and about 200 feet east of the Miller Ridge Road (NW1/4 NE1/4 sec. 26, T. 10 N., R. 14 W.):

O1--1 inch to 0, fine duff, humus, and worm casts.

A11--0 to 11 inches, light yellowish-brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak, fine, granular structure; slightly hard, friable, nonsticky and slightly plastic; many roots, all sizes; slightly acid (pH 6.2); gradual, irregular boundary.

A12--11 to 18 inches, yellowish-brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak, fine, subangular blocky structure; hard, friable, slightly sticky and plastic; common, very fine and fine roots; many, very fine, vesicular pores; medium acid (pH 5.7); gradual, wavy boundary.

A13--18 to 26 inches, yellow (10YR 7/6) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate, fine, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; common fine and very fine roots; common, fine and medium, vesicular pores; medium acid (pH 5.7); gradual, irregular boundary.

B2t--26 to 48 inches, yellowish-brown (10YR 5/8) sandy clay, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, sticky and plastic; a few very fine roots; a few, fine, vesicular pores; a few thin clay films in pores and as bridges; strongly acid (pH 5.3); clear, wavy boundary.

B3t--48 to 54 inches, yellowish-brown (10YR 5/6) sandy clay, dark brown (10YR 4/3) moist; massive; slightly hard, firm, sticky and plastic; a few very fine roots; a few, fine, vesicular pores; common moderately thick clay films in

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pores and as bridges; strongly acid (pH 5.3); diffuse, irregular boundary.

C--54 inches, pale-yellow (5Y 8/4) strongly weathered sandstone and shale.

The A horizon color ranges from pale brown to brown or yellowish brown and from light yellowish brown to yellow. This horizon is heavy loam to heavy clay loam. Depth varies from 40 to 60 inches to weathered soft sandstone and shale.

Included in mapping are small areas of Caspar sandy loam, Empire loam, Goldridge fine sandy loam, and Hugo loam.

Permeability is moderately slow in the subsoil of this Mendocino soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is moderate. The available water capacity is 6 to 10 inches.

This soil is used mainly for the production of timber. Grazing is very limited on areas of this soil that have been cleared. Capability unit VIe-1; woodland group 1.

Mendocino sandy clay loam, 30 to 50 percent slopes (MmF).--This soil is similar to Mendocino sandy clay loam, 9 to 30 percent slopes, but it is 30 to 50 inches deep.

Included in mapping are small areas of Empire loam, Goldridge fine sandy loam, and Hugo loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 8.5 inches.

The soil is used mainly for the commercial production of timber. Grazing is very limited on areas of this soil that have been cleared. Capability unit VIe-1; woodland group 2.

Mendocino-Empire complex, 0 to 50 percent slopes (MnF).--This complex is above the lower coastal bench terraces in the northwestern part of the county, in the vicinity of Stewart's Point, and 10 miles north and northeast of Stewart's Point. Mendocino soils make up about 55 percent of the complex and Empire soils about 45 percent. Some of these soils are steep and are on uplands, but generally they are gently to strongly sloping and are on terraces.

The Mendocino soils have a profile similar to that of Mendocino sandy clay loam, 9 to 30 percent slopes. Runoff is slow to rapid, and the hazard of erosion is slight to high, depending on slope.

The Empire soils have a profile similar to that of Empire loam, 9 to 30 percent slopes. Runoff is slow to rapid, and the hazard of erosion is slight to high, depending on slope.

These soils are used mainly for the production of timber. Capability unit VIe-1; woodland group 2.

Montara Series

The Montara series consists of well-drained cobbly clay loams. These soils are underlain, at a depth of 8 to 20 inches, by weathered serpentine or serpentine rock. They are on hillsides, ridgetops, or mountainous uplands, mainly in hilly mountain ranges in the eastern and northern parts of the county. Slopes are 2 to 75 percent. Elevation ranges from 600 to 2,000 feet. Annual rainfall is 30 to 45 inches, annual temperature is between 57° and 59° F., and the frost-free season is 260 to 285 days. In most places the vegetation is chiefly annual grasses, forbs, and small woody shrubs, but a few areas have scattered scrub oak trees and manzanita. The Montara soils are associated with the Henneke, Raynor, and Yorkville soils.

In a typical profile the surface layer is very dark gray, neutral cobbly clay loam about 9 inches thick. At a depth of about 9 inches is weathered pale-olive and variegated brown, green, and blue serpentine parent material.

Montara soils are used mainly as wildlife habitat, for recreation, and watershed. A few small areas are used for limited grazing.

Montara cobbly clay loam, 2 to 30 percent slopes (MoE).--This soil is in small scattered areas throughout the eastern and northern parts of the county. It is mainly on foothills and ridgetops. Most of the slopes are hummocky or gently undulating.

Typical profile 0.6 mile east of Occidental near the junction of Occidental Road and Facendini Land (NE1/4 SW1/4, sec. 35, T. 7 N., R. 10 W.):

A11--0 to 9 inches, very dark-gray (10YR 3/1) cobbly clay loam, black (10YR 2/1) moist; moderate, fine and medium, subangular blocky structure; slightly hard, firm, sticky and plastic; common fine and very fine roots; common, very fine and fine, tubular pores; a few thin clay films in pores; neutral (pH 7.0); clear, wavy boundary.

R--9 inches, pale-olive and variegated brown, green, and blue serpentine bedrock.

The A horizon ranges from cobbly clay loam to light clay. Occasionally the texture is loam. This horizon ranges in color from very dark gray to dark grayish brown, and is neutral to moderately alkaline. Depth to rock varies from 8 to 20 inches. The content of cobblestones is 15 to 25 percent throughout the profile, and the content of gravel is 15 to 20 percent.

Included in mapping are small areas of Henneke gravelly loam, Raynor clay, and Yorkville clay loam. Also included are scattered areas of serpentine outcrop.

Permeability is moderately slow in this Montara soil. Runoff is slow to rapid, and the hazard of erosion is slight to high. The available water capacity is 1 to 3 inches. Fertility is very low.

This soil is used primarily for range and pasture. Capability unit VIIe-9; range site 11.

Montara cobbly clay loam, 30 to 75 percent slopes (MoG).--This soil is similar to Montara cobbly clay loam, 2 to 30 percent slopes, but it is 8 to 16 inches deep.

Included in mapping are small areas of Henneke gravelly loam and Raynor clay. Also included are scattered outcrops of serpentine rock.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used for limited range, for watershed, as wildlife habitat, and for recreational purposes. Capability unit VIIe-9; range site 11.

Noyo Series

The Noyo series consists of somewhat poorly drained coarse sandy loams that have a clay subsoil. They formed in old marine terrace material that was derived from weathered coarse-grained sandstone. These soils are on ocean terraces and ridgetops. They are in the northwestern part of the county on marine terraces within 5 or 6 miles of the coastline. Slopes are 0 to 15 percent. Elevation ranges from 100 to 1,000 feet. Annual rainfall is 30 to 45 inches, annual temperature is between 54° and 55° F., and the frost-free season is 300 to 310 days. In most places the vegetation is chiefly Bishop pine, manzanita, rhododendron, bracken fern, and small shrub understory. A few areas support tanoak and madrone mixed with scattered Douglas-fir and sparse grass. The Noyo soils are associated with the Caspar, Empire, Hugo, and Rohnerville soils.

In a typical profile the surface layer is light-gray, white, gray, and pale-yellow sandy loam and coarse sandy loam about 29 inches thick. It is very strongly acid and strongly acid. The subsoil is light-gray and brownish-yellow, very strongly acid clay. Pale-yellow, very strongly acid, weakly cemented loamy sand is at a depth of about 53 inches.

Noyo soils are used for very limited grazing in areas supporting sparse grass. The more scenic areas are increasingly being used for homesites and for recreational purposes.

Noyo coarse sandy loam, 0 to 15 percent slopes (NoD).--This nearly level to strongly sloping soil is on terraces. In most places slopes range from 5 to 10 percent.

Typical profile in a smooth, west-facing terrace; slope of 10 percent, 1.7 miles south of Plantation (NW1/4 SW1/4 sec. 4, T. 8 N., R. 13 W.); the profile was moist when examined:

A1--0 to 11 inches, light-gray (10YR 6/1) coarse sandy loam, very dark gray (10YR 3/1) moist; massive, soft, friable, nonsticky and nonplastic; many very fine roots and a few coarse roots; many, very fine, tubular pores; very strongly acid (pH 4.6); 2 to 3 percent charcoal; diffuse boundary.

A21--11 to 20 inches, white (10YR 8/1) and gray (10YR 6/1) sandy loam that has a few, medium, distinct, yellowish-brown mottles; when moist, dark gray (10YR 4/1) and having a few, medium, distinct, dark yellowish-brown mottles; massive; soft, friable, nonsticky and nonplastic; common very fine roots; many, very fine and fine, tubular pores; strongly acid (pH 5.5); 2 to 3 percent charcoal; diffuse, irregular boundary.

A22--20 to 29 inches, pale-yellow (2.5Y 7/4) sandy loam; when moist, light yellowish brown (2.5Y 6/4) and having a few fine, prominent pale-yellow and olive-yellow mottles; massive; soft, friable, nonsticky and nonplastic; a few fine, medium, and coarse roots; many, fine, tubular and interstitial pores; very strongly acid (pH 5.0); clear, wavy, discontinuous boundary with tongues of A22 material descending into the B2t horizon.

B2t--29 to 53 inches, light-gray (N 7/1) and brownish-yellow (10YR 6/8) clay, light gray (10YR 6/1) and brownish yellow (10YR 6/8) moist; strong, coarse, prismatic and strong, coarse, angular blocky structure; extremely hard, firm, plastic and sticky; common fine and medium roots; common, fine, tubular and interstitial pores; many thick clay films on ped faces and in pores; very strongly acid (pH 4.5); pockets of pale-yellow clay, believed to be kaolin; abrupt, wavy boundary.

C--53 to 60 inches, pale-yellow (2.5Y 7/4) loamy sand that has strong-brown (7.5YR 5/8) and light-brown mottles; when moist, pale yellow (2.5Y 7/4) and having strong-brown (7.5YR 5/8) mottles; massive; hard, firm, weakly cemented; very strongly acid (pH 4.5).

The A1 horizon ranges from fine sandy loam to loamy sand. The colors of the B2t horizon vary from pale yellow to yellowish brown and light gray to brownish yellow. Reaction ranges from extremely acid to strongly acid.

Included in mapping are small areas of Caspar sandy loam, Empire loam, Hugo very gravelly loam, and Rohnerville loam.

Permeability is very slow in the subsoil of this Noyo soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is moderately low. The available water capacity is 4 to 6 inches. This soil is drained.

Because of its proximity to the coast and natural beauty, this soil is used mainly for recreation and homesites. Some areas, away from the coast, are used for range. Capability unit IVe-3; range site 2.

Pajaro Series

The Pajaro series consists of somewhat poorly drained fine sandy loams. These soils are underlain by mixed alluvial material derived from a variety of sedimentary sources. The soils are on low terraces and on alluvial flood plains and fans in valley areas. They are mainly in the south-central and southwestern parts of the county between Petaluma and Two Rock but are also in the vicinity of Sebastopol. Slopes are 0 to 5 percent. Elevation ranges from 50 to 300 feet. Annual rainfall is 30 to 35 inches, annual temperature is 51° to 53° F., and the

frost-free season is 250 to 270 days. The vegetation is chiefly of annual and perennial grasses, forbs, low shrubs, and wild berry vines. The Pajaro soils are associated with the Blucher, Goldridge, Los Osos, and Steinbeck soils.

In a typical profile the surface layer is grayish-brown, medium acid fine sandy loam about 4 inches thick. The following layers, to a depth of 60 inches and more, are gray and grayish-brown, mottled, slightly acid and neutral fine sandy loam.

Pajaro soils are used mainly as dryland pasture for dairy cattle and for growing hay. A few small irrigated areas are used for truck crops and pasture. The better drained areas support a few fruit orchards.

Pajaro fine sandy loam, 0 to 2 percent slopes (PaA).--This nearly level soil is on alluvial fans or on low terraces in long narrow valleys.

Typical profile in a pasture, 300 feet due east of the M. Azevedo residence and 300 feet south of Pepper Road (NE corner of NE1/4 NE1/4, sec. 16, T. 5 N., R. 8 W. protected); the profile was dry to a depth of 35 inches and moist below that depth when examined:

Ap--0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, nonsticky and slightly plastic; many very fine roots; many very fine pores; medium acid (pH 6.0); clear, smooth boundary.

C--4 to 35 inches, gray (10YR 5/1) fine sandy loam that has common, large, distinct, yellowish-brown mottles; when moist, dark gray (10YR 4/1) and having many, large, distinct, dark yellowish-brown and grayish-brown mottles; massive; hard, friable, nonsticky and nonplastic; common very fine roots; many very fine pores; slightly acid (pH 6.2); abrupt, smooth boundary.

IIA11b--35 to 54 inches, gray (10YR 5/1) fine sandy loam that has common, fine, distinct, yellowish-brown mottles; when moist, dark gray (10YR 4/1) and having common fine, distinct, brown mottles; massive; hard, friable, nonsticky and nonplastic; a few very fine roots; a few very fine pores; neutral (pH 6.8); diffuse, smooth boundary.

IIA12b--54 to 72 inches, grayish-brown (10YR 5/2) fine sandy loam; when moist, dark grayish brown (10YR 4/2) and having common, fine, distinct, yellowish-brown mottles; massive; hard, friable, nonsticky and nonplastic; slightly acid (pH 6.2); abrupt, smooth boundary.

The A horizon ranges from gray to dark grayish brown in color and has dark-brown or dark yellowish-brown mottling in places. This horizon is massive or has a moderate granular structure. Reaction is medium acid to neutral, and the soil material generally becomes more acid as depth increases. The C horizon ranges from pale brown to dark yellowish brown or gray in color with olive-gray to yellowish-brown mottles. The texture is generally fine sandy loam to sandy loam. This horizon is massive or has subangular blocky to coarse prismatic structure. It is slightly acid to moderately alkaline.

Included in mapping are scattered areas of Steinbeck loam, Blucher loam, and Blucher clay loam.

Permeability is moderately slow in this Pajaro soil. Runoff is very slow, and the hazard of erosion is slight. Seasonal water tables are at a depth of 36 to 60 inches. The available water capacity is 8 to 10 inches. Fertility is moderately high.

This soil is used mainly for grazing livestock. Some areas have been seeded for improved dryland and irrigated pasture. A few areas, where drainage problems are less serious, are being developed for urban use. Generally the soil is too wet during the growing season to grow trees for commercial use, but some of the better drained areas are suitable for this purpose. Capability unit IIw-2.

Pajaro fine sandy loam, 2 to 5 percent slopes (PaB).--This soil is similar to Pajaro fine sandy loam, 0 to 2 percent slopes. It is gently sloping and is on fans or terraces, generally adjacent to the nearly level, lower valley soils. This soil is somewhat better drained than Pajaro fine sandy loam, 0 to 2 percent slopes, and runoff on the surface of this soil is more rapid.

Included in mapping are small areas of Blucher loam, Blucher clay loam, Goldridge fine sandy loam, and Steinbeck loam.

Runoff is slow, and the hazard of erosion is slight.

The soil is used mainly for grazing by sheep and cattle. Some fields are used for producing field corn for silage which can be cultivated earlier in the season. Capability unit IIw-2.

Pajaro gravelly loam, 0 to 5 percent slopes (PbB).--This soil is similar to Pajaro fine sandy loam, 0 to 2 percent slopes, but the surface layer contains 10 to 25 percent fine to medium gravel, by volume. The gravel does not interfere with cultivation. This soil is scattered on fans in small bodies along stream channels in the north-central valleys.

Included in mapping are small areas of Blucher loam, Blucher clay loam, and Steinbeck loam.

Runoff is slow, and the hazard of erosion is slight.

A greater variety of crops is produced on this soil than on Pajaro fine sandy loam, 0 to 2 percent slopes. In a few places, vineyards and pear orchards have been planted in addition to oat hay, row crops, and pasture. Capability unit IIw-2.

Pajaro clay loam, overwash, 0 to 2 percent slopes (PcA).--This soil is similar to Pajaro fine sandy loam, 0 to 2 percent slopes, but the surface layer is clay loam about 12 to 18 inches thick. This soil is in basin areas and along stream channels which frequently overflow. The content of organic matter in

this Pajaro soil is somewhat higher than usual, and the surface layer is very dark gray when wet. The soil is inundated during the rainy season and stays wet until late in spring. It is subject to deposition.

Included in mapping are small areas of Blucher loam, Blucher clay loam, Goldridge fine sandy loam, and Steinbeck loam.

Runoff is very slow, or the surface is ponded. The hazard of erosion is none to slight. The available water capacity is 9 to 11 inches.

The soil is used mainly for pasture, but a few fields have been planted to corn for silage. Capability unit IIIw-2.

Pajaro clay loam, overwash, 2 to 5 percent slopes (PcB).--This soil is similar to Pajaro fine sandy loam, 0 to 2 percent slopes, but the surface layer is clay loam about 10 to 16 inches thick, and there is less stratification in the surface layer. The soil is gently sloping and is on alluvial fans adjacent to lower basic soils. The lower slopes are subject to short periods of inundation. During heavy storms this soil is subject to runoff water from higher elevations and steeper slopes.

Included in mapping are small areas of Blucher clay loam, Los Osos clay loam, and Steinbeck loam.

Runoff is slow, and the hazard of erosion is slight. The available water capacity is 9 to 11 inches.

This soil is used mainly for growing corn for silage, grain hay, and short-season row crops. Capability unit IIIw-2.

Pleasanton Series

The Pleasanton series consists of well-drained gravelly loams that have a gravelly clay loam subsoil. They are underlain by alluvium from mixed sedimentary and basic rock sources. These soils are on terraces and fans. They are mainly in the north-central parts of the county along the Russian River and Dry Creek Valleys. Slopes are 0 to 15 percent. Elevation ranges from 300 to 800 feet. Annual rainfall is 25 to 40 inches, annual temperature is 58° to 60° F., and the frost-free season is 260 to 280 days. In most places the vegetation is chiefly annual and perennial grasses, forbs, small shrubs, wild berry vines, and scattered oaks. The Pleasanton soils are associated with the Arbuckle, Cortina, Yolo, and Zamora soils.

In a typical profile the surface layer is brown, dark grayish-brown, and grayish-brown very strongly acid and strongly acid gravelly loam about 27 inches thick. The subsoil is grayish-brown gravelly loam and brown gravelly clay loam. It is medium acid and is about 28 inches thick. At a depth of about 55 inches is a substratum of yellowish-brown and reddish-brown, medium acid gravelly sandy clay loam.

Pleasanton soils are used for fruit and nut orchards, vineyards, and pasture. A few irrigated areas are used for oat and vetch hay.

Pleasanton gravelly loam, 2 to 5 percent slopes (PgB).--This soil is on bench terraces. Most of the slopes are long and smooth. In most places slope is 2 or 3 percent.

Typical profile 4 miles due north of Healdsburg off U.S. Highway No. 101 on Meier's ranch (NE1/4 NE1/4 sec. 32, T. 10 N., R. 9 W.):

Ap--0 to 7 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; weak, very fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; very strongly acid (pH 4.5); abrupt, wavy boundary.

A11--7 to 17 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; moderate, fine and medium, subangular blocky structure and granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many, very fine, tubular pores; many thin clay films in pores and as bridges; very strongly acid (pH 5.0); gradual, smooth boundary.

A12--17 to 27 inches, grayish-brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure and granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many, very fine, tubular pores; many thin clay films in pores and as bridges and a few moderately thick clay films as bridges; strongly acid (pH 5.5); clear, wavy boundary.

B1--27 to 46 inches, grayish-brown (10YR 5/2) gravelly loam, dark brown (10YR 3/3) moist; weak, fine and medium, subangular blocky structure and granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots and a few coarse roots; many, very fine, tubular pores and a few, fine, interstitial pores; many thin clay films in pores and as bridges; medium acid (pH 6.0); clear, wavy boundary.

B2t--46 to 55 inches, brown (10YR 5/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; moderate, fine, subangular blocky structure and granular structure; hard, friable, sticky and plastic; common very fine roots and a few medium roots; common, very fine, tubular pores; many thin clay films; medium acid (pH 6.0); clear, irregular boundary and clear, wavy boundary.

C--55 to 72 inches, yellowish-brown (10YR 5/4) and reddish-brown (5YR 4/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) moist; massive; hard, firm, sticky and plastic; a few very fine roots; common, very fine, tubular pores and a few, fine, interstitial pores; common thin and moderately thick clay films; medium acid (pH 6.0).

The Ap horizon ranges in reaction from very strongly acid to medium acid. Gravel content ranges

from 10 to 30 percent, by volume. The B horizon ranges in color from brown to yellowish-brown or grayish-brown, and from gravelly clay loam to loam. Gravel content generally increases with depth but does not exceed 35 percent in the B2t horizon. Streaks of gravel and cobblestones may be present in the C horizon.

Included in mapping are small areas of Arbuckle gravelly loam, Cortina very gravelly loam, Yolo loam, and Zamora silty clay loam.

Permeability is moderately slow in the subsoil of this Pleasanton soil. Runoff is slow, and the hazard of erosion is slight. The available water capacity is 8 to 10 inches. Fertility is high.

This soil is used for a wide variety of crops, but it is used mainly for prune orchards and vineyards. This soil is also used for irrigated and dry pasture. Capability unit IIe-1.

Pleasanton loam, 0 to 2 percent slopes (PeA).--This soil is similar to Pleasanton gravelly loam, 2 to 5 percent slopes, but generally the surface layer of this soil does not contain gravel. Gravel generally is in the subsoil, however, and it tends to increase with depth.

Included in mapping are small areas of Arbuckle gravelly loam, Cortina very gravelly sandy loam, and Yolo gravelly loam.

The available water capacity is 9 to 11 inches.

This soil is used mainly for prune orchards and vineyards, although there are small areas of other fruit crops and dry and irrigated pasture. Capability unit I

Pleasanton loam, 2 to 9 percent slopes (PeC).--This soil is similar to Pleasanton gravelly loam, 2 to 5 percent slopes, but the surface layer of this soil does not contain gravel. Gravel is in the subsoil, however, and it tends to increase with depth.

Included in mapping are small areas of Arbuckle gravelly loam, Yolo loam, and Zamora silty clay loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 9 to 11 inches. Most of the soil has 2 to 5 percent slopes, but in some areas of transition to other series or land forms slopes are 6 to 9 percent.

This soil is used mainly for prune orchards and vineyards. Small areas of this soil are used for other fruit crops and for dry pastures. Capability unit IIe-1.

Pleasanton clay loam, 2 to 5 percent slopes (PhB).--This soil is similar to Pleasanton gravelly loam, 2 to 5 percent slopes. Texture of the surface layer varies from heavy loam to clay loam, and some areas contain up to 10 percent gravel. Depth to the substratum ranges from 30 to more than 50 inches. Gravel content of the substratum ranges from 40 to 90 percent, by volume.

Included in mapping are small areas of Arbuckle gravelly loam, Cortina very gravelly loam, and Zamora silty clay loam.

The available water capacity is 9 to 11 inches.

This soil is used mainly for vineyard and pasture, but the areas near Santa Rosa are rapidly being converted to homesites. Most of this soil is in pasture. Some areas will continue to provide forage for riding horses and a few feeder lambs and calves. Capability unit IIe-1.

Pleasanton gravelly clay loam, 2 to 9 percent slopes (PkC).--This soil is similar to Pleasanton gravelly loam, 2 to 5 percent slopes, but generally is moderately sloping. The surface layer is gravelly clay loam and contains 10 to 25 percent gravel, by volume. Although gravel content varies considerably, it generally increases with depth and ranges from 40 to 90 percent, by volume, in the substratum.

Included in mapping are small areas of Arbuckle gravelly loam, Yolo gravelly loam, and Zamora silty clay loam. Also included are some soils that have slopes of up to 15 percent.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 8 to 10 inches.

This soil is used mainly for vineyards and pasture. Some areas in the vicinity of Santa Rosa, however, have been converted to homesites. Capability unit IIe-1.

Pleasanton-Haire complex, 0 to 9 percent slopes (PlC).--This complex is east of Santa Rosa, extending along Calif. Highway No. 12 toward Kenwood, and between Dry Creek and the Russian River west of Geyserville.

Pleasanton clay loam makes up about 60 percent of the complex, and Haire gravelly loam about 40 percent. The Haire soil frequently is in small concave positions within areas of Pleasanton soil. The Haire soil has a clay subsoil which restricts penetration of roots and water. Occasionally, surface wet spots or seeps indicate this condition. Both soils have variable amounts of gravel.

The Pleasanton clay loam has a profile similar to that of Pleasanton gravelly loam, 2 to 5 percent slopes, but the surface layer is clay loam or heavy loam. Runoff is slow to medium, and the hazard of erosion is slight.

The Haire gravelly loam has a profile similar to that of Haire clay loam, 0 to 9 percent slopes, but the surface layer is gravelly loam. Runoff is slow to medium and the hazard of erosion is slight to moderate.

These soils are used mainly for pasture, orchards, and vineyards. Some areas east of Santa Rosa, however, have been converted to homesites. Capability unit IIIe-3.

Pleasanton-Haire complex, 9 to 15 percent slopes (PlD).--This complex is similar to Pleasanton-Haire complex, 0 to 9 percent slopes, but the Haire soil in this complex is not so confined to concave or depressional positions. Also, the difference in the positions of the two soils is not so evident as it is on the less slopes. Pleasanton gravelly loam makes up about 60 percent of the complex, and Haire gravelly loam about 40 percent.

Pleasanton gravelly loam has a profile similar to that of Pleasanton gravelly loam, 2 to 5 percent slopes. Runoff is medium, and the hazard of erosion is high.

Haire gravelly loam has a profile similar to that of Haire clay loam, 0 to 9 percent slopes, but it has a gravelly loam surface layer and contains up to 20 percent gravel throughout the profile. Runoff is medium, and the hazard of erosion is high.

These soils are used mainly for pasture and vineyards. Use of the soils for homesites has been limited. Capability unit IVe-3.

Positas Series

The Positas series consists of well-drained gravelly loams that have a clay subsoil. They are underlain by old alluvium of mixed sedimentary and basic igneous material. These soils are on river valley terraces, mainly in the north-central part of the county along the Russian River in the Alexander Valley. Slopes are 0 to 15 percent. Elevation ranges from 200 to 600 feet. Annual rainfall is 30 to 45 inches, annual temperature is 58° to 60° F., and the frost-free season is 260 to 280 days. The vegetation is chiefly annual and perennial grasses, forbs, small shrubs, and scattered oak trees. Most areas have been cultivated, however, and are used for orchards, vineyards, or pasture. The Positas soils are associated with the Haire, Manzanita, Pleasanton, and Zamora soils.

In a typical profile the surface layer is brown, medium acid gravelly loam and strongly acid clay loam about 15 inches thick. The subsoil is brown clay loam and dark-brown and reddish-brown clay. It is medium acid to neutral and about 32 inches thick. The substratum, at a depth of about 47 inches, is brown, neutral gravelly clay.

Positas soils are used mainly for prune orchards, vineyards, and dry and irrigated pasture.

Positas gravelly loam, 0 to 9 percent slopes (PsC).--This soil generally has smooth rolling slopes. Small areas are on old terraces and on nearly level topography.

Typical profile in an orchard in good condition; slope of 1 percent; 50 feet south of Sausal Creek Road and 800 feet southwest of the junction of Sausal Creek Road and Calif. Highway No. 128 (SW1/4 NE1/4 sec. 1, T. 9 N., R. 9 W.); the profile was moist throughout when examined:

Ap1--0 to 7 inches, brown (10YR 5/3) gravelly loam, dark-brown (7.5YR 3/2) moist; massive; hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine and fine, interstitial and tubular pores; medium acid (pH 5.8); clear, wavy boundary.

Ap2--7 to 15 inches, brown (10YR 5/3) clay loam, dark reddish brown (5YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and medium roots; many, very fine and fine, interstitial and tubular pores; strongly acid (pH 5.3); clear, wavy boundary.

B1--15 to 22 inches, brown (10YR 5/3) clay loam, dark reddish brown (5YR 3/3) moist; massive; very hard, friable, sticky and slightly plastic; common very fine roots; many, very fine and fine, interstitial and tubular pores; very thin clay films; many worm casts; medium acid (pH 6.0); abrupt, wavy boundary.

B21t--22 to 38 inches, dark-brown (7.5YR 3/2) clay, dark reddish brown (5YR 3/3) moist; massive; hard, very firm, sticky and very plastic; a few very fine and fine roots; a few, very fine, tubular and interstitial pores; moderately thick clay films and slickensides; a few, round, shotlike pisoliths; slightly acid (pH 6.2); clear, wavy boundary.

B22t--38 to 47 inches, reddish-brown (5YR 4/3) clay, dark reddish brown (5YR 3/2) moist; massive; hard, firm, slightly sticky and very plastic; common very fine roots; many, very fine and fine, tubular and interstitial pores; continuous moderately thick clay films in pores; slickensides; neutral (pH 7.0); clear, wavy boundary.

C--47 to 60 inches, brown (10YR 5/3) gravelly clay; when moist; dark grayish brown (10YR 4/2) and having grayish-brown mottles and stains; massive; hard, firm, sticky and plastic; a few very fine and fine roots; a few, very fine and fine, tubular and interstitial pores; many moderately thick clay films in pores and as bridges; neutral (pH 7.0).

The A horizon ranges from brown to reddish brown in color. The gravel content of this horizon ranges from 10 to 35 percent, by volume. The A horizon is 15 to 36 inches thick.

Included in mapping are small areas of Clough gravelly loam, Haire gravelly loam, Manzanita gravelly silt loam, Pleasanton gravelly loam, and Zamora silty clay loam.

Permeability is very slow in the subsoil of this Positas soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is moderate. The available water capacity is 4 to 7 inches and is restricted in the clay subsoil.

This soil is used mainly for prune orchards, vineyards, and pastures. Capability unit IIIe-3.

Positas gravelly loam, 9 to 15 percent slopes (PsD).--This soil is similar to Positas gravelly loam, 0 to 9 percent slopes. The surface layer is 18 to 30 inches thick. Generally this layer contains 10 to 30 percent medium-sized gravel, by volume.

Included in mapping are small areas of Clough gravelly loam, Haire gravelly loam, and Pleasanton gravelly loam.

Runoff is medium and the hazard of erosion is moderate. The available water capacity is 4 to 6 inches and is limited to the clay subsoil.

This soil is primarily used for vineyard and pasture. Capability unit IVe-3.

Raynor Series

The Raynor series consists of well-drained clays underlain, at a depth of 20 to 60 inches, by volcanic and andesitic rocks. These soils are on rolling hills. They are mainly in the southern third of the county and in small areas in other parts of the county. Slopes are 2 to 30 percent. Elevation ranges from 200 to 1,200 feet. Annual rainfall is 22 to 35 inches, annual temperature is 58° to 60° F. and the frost-free season is 260 to 290 days. The vegetation is chiefly annual grasses, forbs, and a few scattered oaks. The Raynor soils are associated with the Clear Lake, Cotati, Diablo, and Goulding soils.

In a typical profile the surface layer is black and olive-gray, slightly acid to moderately alkaline clay about 47 inches thick. At a depth of about 47 inches is pale-olive, moderately alkaline very cobbly and stony clay. Basaltic cobblestones and stones are at a depth of 56 inches.

Raynor soils are used mainly for sheep and cattle grazing. A few fields on lesser slopes are used for growing oat and vetch hay.

Raynor clay, 2 to 9 percent slopes (RaC).--Most of this soil is gently sloping and is on the lower foothills. In many places, the Raynor soils are in small patches that are surrounded by Goulding soils.

Typical profile in a pasture in fair condition; south-facing slope of 8 percent; 3 miles north of the junction of Old Adobe Road and Lynch Lane (SE1/4 NE1/4 sec. 34, T. 6 N., R. 7 W.); the profile was moist below a depth of 18 inches when examined:

A11--0 to 17 inches, black (10YR 2/1) clay, black (N 2/0) moist; the upper half inch of this horizon has strong, moderate, granular structure, and the remainder has strong, coarse, prismatic structure; very hard, very firm, very sticky and very plastic; many very fine roots; many, very fine, tubular pores; slightly acid (pH 6.5); gradual, smooth boundary.

A12--17 to 35 inches, black (N 2/0) clay, black (N 2/0) moist; weak, coarse, angular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; common, very fine, tubular pores; mildly alkaline (pH 7.5); gradual, smooth boundary.

A13--35 to 47 inches, olive-gray (5Y 4/2) clay; when moist, dark olive gray (5Y 3/2) and having black streaks one-eighth to three-quarter inch wide which are inclined 90 to 30 degrees from the horizontal; massive; very hard, very firm, very sticky and very plastic; a few very fine roots; common, very fine, tubular pores; moderately alkaline (pH 8.0); gradual, smooth boundary.

IIC1--47 to 56 inches, pale-olive (5Y 6/3) very cobbly and stony clay; when moist, dark olive gray (5Y 3/2), olive gray (5Y 4/2), and light olive gray (5Y 6/2); massive; hard, friable, nonsticky and slightly plastic; a few very fine roots; moderately alkaline (pH 8.0).

IIC2--56 inches, basaltic cobblestones and stones.

The depth to the IIC2 horizon varies from 36 to 56 inches. Where this soil joins the Clear Lake or Diablo series there may be small amounts of lime in the lower part of the A horizon. The cobbly and stony IIC horizon contains over 50 percent hard, coarse, basalt fragments.

Included in mapping are small areas of Clear Lake clay, Cotati fine sandy loam, Diablo clay, and Goulding cobbly clay loam. Also included are areas with up to 10 percent of the surface covered by rock outcrops or stones which have rolled downhill from adjacent steeper areas.

Permeability is slow in this Raynor soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is moderate. The available water capacity is 5 to 9 inches.

This soil is used mainly for pasture. Capability unit IIe-5.

Raynor clay, 9 to 15 percent slopes (RaD).--This soil is similar to Raynor clay, 2 to 9 percent slopes, but is only 20 to 40 inches deep.

Included in mapping are small areas of Cotati fine sandy loam, Diablo clay, and Goulding cobbly clay loam.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 3 to 6 inches.

The primary use of this soil is for pasture for dairy cattle. Dairy operations are common in the south-central part of the county near Petaluma. Capability unit IIIe-5.

Raynor clay, 15 to 30 percent slopes (RaE).--This soil is similar to Raynor clay, 2 to 9 percent slopes, but is only 20 to 40 inches deep and is steeper. On drying, the soil develops large, deep, irregular cracks.

Included in mapping are small areas of Diablo clay and Goulding cobbly clay loam. Also included are areas that have rock cropping out on about 15 percent of the surface.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 3 to 6 inches.

This soil is used mainly for pasture for dairy cattle. Sheep graze in some areas near the coast in the vicinity of Jenner. Capability unit IVe-5; range site 3.

Raynor clay, seeped, 2 to 15 percent slopes (RcD).--This soil is similar to Raynor clay, 2 to 9 percent slopes, but retains water for longer periods throughout the year. This soil formed in basins or in swales on seepy hillsides. Depth to bedrock ranges from 45 to 60 inches.

Included in mapping are small areas of Diablo clay and Goulding cobbly clay loam.

Fertility is moderately high. The available water capacity is 6 to 9 inches.

This soil is used mainly for grazing. Capability unit VIw-5; range site 3.

Raynor-Montara complex, 0 to 30 percent slopes (ReE).--This complex is in the uplands north of

Digger Bend and 0.5 mile to 2 miles north of Jenner. Raynor clay and Montara cobbly clay loam are about evenly divided in this complex. Included in mapping are 5 percent or less of Suther soils in small areas. Also included are Goulding, Diablo, and Spreckels soils. Rock frequently crops out on Montara soils.

The Raynor soil has a profile similar to that of Raynor clay, 2 to 9 percent slopes. Runoff is slow to rapid, and the hazard of erosion is slight to high. The available water capacity is 3 to 9 inches. Depth is 20 to 50 inches.

The Montara soil has a profile similar to that of Montara cobbly clay loam, 2 to 30 percent slopes. Runoff is slow to rapid, and the hazard of erosion is slight to high.

The main use of these soils is for range and pasture. Capability unit VIe-5; Raynor, range site 3; Montara, range site 11.

Red Hill Series

The Red Hill series consists of moderately well drained clay loams that have a predominantly clay subsoil. They are underlain, at a depth of 30 to 60 inches, by mixed greenstone and andesitic basalt rock. These soils are on ridgetops and mountainous uplands. They are in the north-central and eastern parts of the county and in the southeastern hills on both sides of the Valley of the Moon. Slopes are 2 to 75 percent. Elevation ranges from 500 to 2,500 feet. Annual rainfall is 30 to 50 inches, annual temperature is 53° to 55° F., and the frost-free season is 240 to 260 days. In most places the vegetation is Douglas-fir, madrone, oaks, and associated shrubs. Many of the more open hillsides have a sparse cover of grass under the trees and shrubs. The Red Hill soils are associated with the Boomer, Goulding, Josephine, and Sites soils.

In a typical profile the surface layer is brown and reddish-brown, slightly acid clay loam about 16 inches thick. This layer is covered with a mixed litter of Douglas-fir needles and deciduous leaves about 2 inches thick. The subsoil, to a depth of 74 inches, is reddish-brown clay loam and heavy clay loam and reddish-brown and yellowish-red clay. Reaction in the subsoil is medium acid.

Red Hill soils are used mainly for producing timber. Some areas are used for limited grazing by sheep and cattle. A few areas on lesser slopes are used for vineyards, small fruit orchards, and dry-land pasture.

Red Hill clay loam, 30 to 50 percent slopes (RhF).--This steep soil generally is on hills within 3 to 5 miles of the county's major valleys. Much of the acreage is on both sides of Sonoma Valley and east of the central Santa Rosa Plains. The slopes are dominantly 30 to 40 percent.

Typical profile in a timber-covered hillside in good condition; east-facing slope of 45 percent; about 2,200 feet northwest of the west end of the Trenton steel bridge on Red Hill (northwest corner of SW1/4 NW 1/4 sec. 29, T. 8 N., R. 9 W.); the profile was moist throughout when examined:

O1--2 inches to 0, duff layer of mixed litter of Douglas-fir needles and deciduous leaves.

A11--0 to 3 inches, brown (7.5YR 5/4) clay loam, dark reddish-brown (5YR 3/3) moist; medium granular structure; soft and slightly hard, very friable, slightly sticky and slightly plastic; a few fine roots; common tubular pores; slightly acid (pH 6.5); a few burrows; abrupt, wavy boundary.

A12--3 to 16 inches, reddish-brown (5YR 4/4) clay loam, dark reddish-brown (5YR 3/3) moist; fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many, very fine and fine, tubular and interstitial pores; slightly acid (pH 6.3); worm burrows; diffuse, wavy boundary.

B1--16 to 35 inches, reddish-brown (5YR 5/4) clay loam, dark reddish-brown (2.5YR 3/4) moist; medium and fine granular structure; slightly hard, very friable, sticky and plastic; a few medium roots and many very fine and fine roots; many, very fine and fine, tubular and interstitial pores; medium acid (pH 5.8); diffuse, wavy boundary.

B21t--35 to 50 inches, reddish-brown (5YR 5/4) heavy clay loam, dark reddish-brown (2.5YR 3/4) moist; fine granular structure; slightly hard, very friable, sticky and plastic; a few medium roots and common very fine and fine roots; common, fine, tubular and interstitial pores; medium acid (pH 5.8); diffuse, wavy boundary.

B22t--50 to 62 inches, reddish-brown (5YR 5/4) clay, dark reddish-brown (2.5YR 3/4) moist; massive; slightly hard, friable, sticky and plastic; a few coarse roots and common fine roots; common, fine, tubular and interstitial pores; many moderately thick clay films on ped faces and in pores; a few fine pebbles; medium acid (pH 5.8); clear, wavy boundary.

B3--62 to 74 inches, yellowish-red (5YR 5/6) clay, dark reddish-brown (2.5YR 3/4) moist; massive; hard, friable, sticky and plastic; a few coarse roots and common fine roots; common, fine, tubular and interstitial pores; common thin clay films on ped faces; medium acid (pH 6.0); concretions 1 to 3 millimeters in diameter.

The A horizon ranges in color from brown or strong brown to reddish brown. The B horizon is reddish brown or yellowish red. Occasionally it is dark reddish brown. The metamorphosed basic igneous rock ranges from 50 to more than 60 inches in depth and is usually very weathered. The surface layer is cobbly clay loam in some places.

Included in mapping are small areas of Boomer loam, Goulding clay loam, Goulding cobbly clay loam, Josephine loam, and Sites loam.

Permeability is moderately slow in this Red Hill soil. Runoff is rapid, and the hazard of erosion is high. Fertility is moderately high, and the available water capacity is 11 to 13 inches.

This soil is used mainly for producing timber. A few cleared areas are used for grazing. Capability unit VIe-1; woodland group 7.

Red Hill clay loam, 2 to 15 percent slopes (RhD).--This soil is similar to Red Hill clay loam, 30 to 50 percent slopes, but is not so steep. It ranges from 48 to more than 60 inches in depth.

Included in mapping are small areas of Boomer loam and Goulding clay loam.

Runoff is medium, and the hazard of erosion is moderate.

Some prune orchards, vineyards, and pastures have been planted on this soil. Where water is available, some lower slopes are irrigated to improve growth. Capability unit IIIe-1; woodland group 1.

Red Hill clay loam, 15 to 30 percent slopes (RhE).--This soil is similar to Red Hill clay loam, 30 to 50 percent slopes.

Included in mapping are small areas of Boomer loam, Goulding clay loam, and Josephine loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Most of this soil has been cleared and is used for grazing. Some cleared areas have been used for pasture or vineyards. Capability unit IVe-1; woodland group 1.

Red Hill cobbly clay loam, 30 to 75 percent slopes (RlG).--This soil is similar to Red Hill clay loam, 30 to 50 percent slopes, but the surface layer contains 20 to 35 percent cobblestones, by volume. Soil depth ranges from 30 to 50 inches.

Included in mapping are small areas of Boomer loam, Goulding cobbly clay loam, and Josephine loam.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high. The available water capacity is 5 to 11 inches.

This soil is used mainly for producing timber. Much of this mapping unit has been cleared and is used for grazing. Capability unit VIIe-7; woodland group 9.

Reyes Series

The Reyes series consists of poorly drained silty clays that formed in mixed bay and stream alluvium. These soils are in salt water marshes adjacent to bodies of sea water. They are mainly in the southeastern part of the county next to San Pablo Bay at the southern ends of the Sonoma and Petaluma Valleys. Slopes are 0 to 2 percent. Elevation ranges from 2 feet below sea level to 10 feet above. Annual rainfall is 20 to 35 inches, annual temperature is 60° to 62° F., and the frost-free season is 280 to 300 days. The vegetation in uncultivated areas is chiefly annual grasses, salt grasses, coyote brush, bulrushes, and pickleweed. Most of the areas have been diked and cultivated and have a cover of oat hay. Reyes soils are associated with the Clear Lake, Diablo, and Haire soils.

In a typical profile the surface layer is light brownish-gray and grayish-brown, extremely acid silty clay about 14 inches thick. The subsoil is light brownish-gray and light-gray, mottled, very strongly acid silty clay about 17 inches thick. At a depth of about 31 inches is gray, mottled, very strongly acid silty clay about 20 inches thick. This is underlain by muck and plant remains mixed with gray and black silty clay.

Reyes soils are used mainly for oat hay and dryland pasture. Occasionally, the oats have matured and produced grain.

Reyes silty clay, 0 to 2 percent slopes (RmA).--This soil is on tidal flats. Nearly all slopes are 1 percent or less.

Typical profile at an elevation of 1 foot below sea level; slope of 1 percent; in an oat field on Leveroni Road, 57° and 3,800 feet from railroad bridge at Wingo. (This is a nonsectionalized area, but the projected section would be SW1/4 SW1/4 sec. 4, T. 4 N., R. 5 W.):

Ap1--0 to 7 inches, light brownish-gray (10YR 6/2) silty clay, dark brown (10YR 3/3) moist; strong, fine, granular structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many, very fine and fine, interstitial pores; extremely acid (pH 4.0); gradual, smooth boundary.

Ap2--7 to 14 inches, grayish-brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong, fine, granular structure; hard, friable, sticky and plastic; many very fine and fine roots; many, very fine and fine, tubular and interstitial pores; extremely acid (pH 4.3); abrupt, wavy boundary.

B21--14 to 22 inches, light brownish-gray (10YR 6/2) silty clay that has common, fine, distinct, brownish-yellow and light-gray mottles; when moist, dark gray (10YR 4/1) and having common, fine, distinct, strong-brown mottles; many very dark-brown and strong-brown root channels; weak, coarse, subangular blocky structure; extremely hard, firm, sticky and plastic; many very fine and fine roots; many, very fine and fine, tubular pores; very strongly acid (pH 4.5); gradual, smooth boundary.

B22--22 to 31 inches, light-gray (5Y 6/1) silty clay that has common, fine, prominent, strong-brown and black mottles and a few streaks of very dark grayish brown; when moist, dark gray (10YR 4/1) and having strong-brown mottles; light-gray root stains, strong brown and very dark brown moist; weak, very coarse, prismatic structure; extremely hard, firm, sticky and very plastic; many very fine and fine roots; common, very fine and fine, tubular pores; very strongly acid (pH 4.5); gradual, smooth boundary.

C1g--31 to 51 inches, gray (N 6/0) silty clay that has common, fine, prominent, strong-brown mottles; when moist, dark gray (5Y 4/1) and having common, fine, prominent, brown and strong-brown mottles; stains on cleavage planes; moderate, very coarse, prismatic structure; extremely hard, firm, sticky and plastic; many very fine and fine roots along ped faces; many, very fine and fine, tubular pores; very strongly acid (pH 4.5); gradual, smooth boundary.

IIC2g--51 to 63 inches, mixed gray (N 5/0) and black (N 2/0) silty clay, muck, and plant remains that have a few, fine, distinct, yellowish-brown (10YR 5/6) mottles; when moist, mixed dark gray (5Y 4/1) and black (N 5/0) and having dark greenish-gray (5GY 4/1) blotches; massive; extremely hard, firm, sticky and plastic; common, very fine and fine, tubular pores; hydrogen sulfide odor; extremely acid (pH 4.0) to medium acid (pH 6.0).

The A horizon ranges in color from grayish brown to light gray. In the B horizon there is a variation in the rate of chemical oxidation and reduction. There is also a variation in quantity of plant remains and humus. Texture of the B horizons varies considerably, depending upon the percentage of fine material and humus. The texture is mainly silty clay, but there are areas of clay loam and highly organic light clay. Streaks of dark brown, strong brown, reddish brown, brownish yellow, black, reddish orange, dark greenish gray, gray, and dark gray are present, generally below a depth of 2 feet. This soil is underlain by muck of mixed river and bay sediments. The upper boundary of this deep muck is undulating and may be as shallow as 3 feet or as deep as 7 to 8 feet from the surface. The water table fluctuates. During the wet winter months it may be at the surface, but it may lower to a depth of 5 or 6 feet as the soil dries out. The subsoil water level is influenced directly by the proximity of the soil bodies to natural drainageways and to the artificial drains, levees, and floodgates that were constructed to help remove excess water. Without seasonal rainfall to flush out the soil, it is doubtful if the soil could produce crops.

Included in mapping are small areas of Clear Lake clay, Diablo clay, and Haire clay loam. There are also small isolated areas of drainageways and unreclaimed Tidal marsh.

Virgin soils of this area are generally neutral in reaction, but after many years of cultivation, the surface layer has become more and more acid. This is the result of the oxidation of sulfides in the soil under altered drainage. When the soil is opened, as it is for the construction of deep drains, there is an overpowering "rotten egg" odor when hydrogen sulfide gas is released.

Permeability is slow in this Reyes soil. Runoff is very slow to ponded, and the hazard of erosion is none to slight. Fertility is moderate. The available water capacity is 8 to 10 inches.

The soil is used mainly for producing oat hay for racehorse feed. After the crop is harvested, dairy cattle and sheep graze the stubble and remaining hay. Occasionally oats have been threshed for grain. A few fields have been planted in safflower. This soil is subject to inundation when not protected by levees. Capability unit IVw-9.

Riverwash

Riverwash (RnA) consists of very recent depositions of gravel, sand, and silt alluvium along major streams and their tributaries. Gravel bars make up the majority of these areas. During floods, alluvial areas are subject to repeated deposition, erosion, and shifting of transported material. Layering and gullying of soil and gravel brought from upstream areas has resulted.

Riverwash provides gravel for commercial production, construction, and road fill. Capability unit VIIIw-4.

Rock Land

Rock land (RoG) consists of stony steep slopes and ridges that generally are in rough mountainous areas where there is little soil material. Small shrubs or an occasional stunted tree growing between lichen-covered rocks are the only vegetation.

This land type is used mainly for watershed. Capability unit VIIIs-8.

Rohnerville Series

The Rohnerville series consists of moderately well drained loams that have a subsoil of mainly sandy clay. They formed in material weathered from soft sandstone. These soils are on marine and bench terraces. They are along the ocean coastal areas between the shoreline and 3 to 4 miles inland. Slopes are 0 to 15 percent. Elevation ranges from 100 to 1,000 feet. Annual rainfall is 30 to 45 inches, annual temperature is 52° to 54° F., and the frost-free season is 290 to 310 days. In most places the vegetation is chiefly annual and perennial grasses and legumes. A few areas, however, have a dryland pasture cover. The Rohnerville soils are associated with the Baywood, Kinman, Kneeland, and Noyo soils.

In a typical profile the surface layer is dark grayish-brown, strongly acid loam and medium acid silt loam about 16 inches thick. The subsoil is light brownish-gray medium acid sandy clay loam and light yellowish-brown sandy clay about 19 inches thick. Brownish-yellow strongly acid sandy clay loam and sandy clay are at a depth of 35 inches and extend to a depth of more than 60 inches.

Rohnerville soils are used for grazing by sheep and cattle. A few scattered areas on low slopes have been planted and used for dryland pasture or hay.

Rohnerville loam, 0 to 9 percent slopes (RrC).--This soil is along the coastal terraces from Gualala to Bodega Bay. Generally, it is nearly level, but where this soil is on a rise abutting the steep uplands adjacent to the terrace, it is gently sloping.

Typical profile 1,000 feet east of the Pacific Ocean and 375 feet north of Coleman Valley Road (SW1/4 NW1/4 sec. 15, T. 6 N., R. 11 W.):

A11--0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate, medium, granular structure but upper 2 inches has fine granular structure; soft, very friable, slightly sticky and slightly plastic; many micro and very fine roots; many, very fine and fine, tubular pores; strongly acid (pH 5.5); clear, wavy boundary.

A12--5 to 16 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate, medium and fine, granular structure; slightly hard, friable, sticky and slightly plastic; many micro and very fine roots; a few, very fine, tubular pores; worm activity; medium acid (pH 5.7); clear, wavy boundary.

B21t--16 to 25 inches, light brownish-gray (10YR 6/2) sandy clay loam; when moist, very dark grayish-brown (10YR 3/2) and having common, fine, faint, light yellowish-brown mottles; weak, medium and coarse, subangular blocky structure; hard, friable, sticky and slightly plastic; many micro and very fine roots; many, very fine, tubular pores; common thin and moderately thick clay films as bridges; scattered manganese stains; medium acid (pH 5.7); clear, wavy boundary.

B22t--25 to 35 inches, light yellowish-brown (10YR 6/4) sandy clay that has many large, distinct, brownish-yellow mottles; when moist, dark brown (10YR 4/3) and having many, large, distinct, yellowish-brown mottles and a few, fine, prominent, black stains; moderate, medium and coarse, subangular blocky structure; extremely hard, friable, sticky and plastic; common micro and very fine roots; many, very fine, tubular pores; continuous moderately thick clay films on ped faces; manganese stains throughout horizon; medium acid (pH 5.7); abrupt, irregular boundary.

C1--35 to 44 inches, brownish-yellow (10YR 6/6) sandy clay loam; when moist, yellowish-brown (10YR 5/6) and having many, medium, distinct, lighter yellowish-brown mottles and many, large, prominent, very dark-gray and black iron and manganese mottles; massive; extremely hard, very firm, slightly sticky and slightly plastic; a few micro and very fine roots; many, very fine, tubular pores; continuous moderately thick and thick clay films in pores; contains very fine silty rodlike plugs about 12 millimeters in diameter which are horizontally oriented; strongly acid (pH 5.5); abrupt, irregular boundary.

C2--44 to 60 inches, brownish-yellow (10YR 6/6) sandy clay that has many, medium, distinct, brownish-yellow mottles; when moist, yellowish brown (10YR 5/6) and having many, medium, distinct, yellowish-brown mottles; moderate, coarse and very coarse, subangular blocky structure; extremely hard, firm, slightly sticky and slightly plastic; a few micro roots; many, very fine tubular pores; continuous moderately thick clay films in pores, as bridges, and on ped faces; intense worm activity; tongues of manganese-stained material, 4 inches or more in width that extend from C1 horizon; strongly acid (pH 5.5).

The A horizon ranges from dark grayish brown to brown in color and from sandy loam to clay loam in texture. The B horizon ranges in texture from sandy clay loam to sandy clay, and mottles are light brownish gray or light yellowish brown. The solum is 30 to 48 inches thick.

Included in mapping are small areas of Baywood loamy sand, Kinman loam, Kneeland loam, and Noyo coarse sandy loam.

Permeability is moderately slow in this Rohnerville soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is moderate. The available water capacity is 4.5 to 8 inches.

The soil is used mainly for sheep pasture and range. In the past, row crops such as beans, potatoes, and peas were grown. Capability unit IIIe-1; range site 1.

Rohnerville loam, 9 to 15 percent slopes (RrD).--This soil is similar to Rohnerville loam, 0 to 9 percent slopes, but it is generally 30 to 40 inches deep to the substratum. In most areas this soil has slopes of 9 to 12 percent.

Included in mapping are small areas of Kinman loam, Kneeland, loam, and Noyo coarse sandy loam.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 4.5 to 7 inches.

This soil is used mainly for pasture for sheep and a few dairy cattle. Capability unit IVe-1; range site 1.

Sebastopol Series

The Sebastopol series consists of well-drained sandy loams that have a clay subsoil and are formed from soft sandstone. These soils are on hilly terraces. They are mainly in the west central part of the county in the vicinity of Sebastopol. Slopes are 2 to 30 percent. Elevation ranges from 300 to 1,000 feet. Annual rainfall is 30 to 50 inches, annual temperature is 54° to 56° F., and the frost-free season is 240 to 260 days. The vegetation in uncultivated areas is chiefly stands of oak, madrone, and conifers, and there is grass in the openings. Most areas have been cleared, however, and are covered with fruit orchards, small vineyards, or pasture. The Sebastopol soils are associated with the Blucher, Cotati, Goldridge, and Pajaro soils.

In a typical profile the surface layer is pale-brown, very strongly acid and very pale brown, medium acid sandy loam about 8 inches thick. The subsoil is pale-brown light sandy clay loam and light red heavy clay loam and clay. This layer is very strongly acid and extremely acid. It is about 35 inches thick. Light reddish-brown and reddish-yellow, extremely acid heavy clay loam is at a depth of 43 inches and extends to a depth of over 60 inches.

Sebastopol soils are used mainly for apple orchards and vineyards. A few areas are irrigated and used for pasture and hay crops. A few acres are used for the commercial production of berries. Other areas are used for range.

Sebastopol sandy loam, 9 to 15 percent slopes (SbD).--This is a moderately fertile, well-drained sandy loam on terraces. Most of the slopes range from 9 to 12 percent.

Typical profile on Marshall Ranch (the northeast corner of SW1/4 SW1/4 sec. 22, T. 7 N., R. 9 W.):

Ap1--0 to 4 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; massive, soft, friable, nonplastic and nonsticky; many, fine, interstitial pores; very strongly acid (pH 5.0); abrupt, wavy boundary.

Ap2--4 to 8 inches, very pale brown (10YR 7/4) sandy loam, brown (10YR 4/3) moist; massive; slightly hard, firm, nonsticky and nonplastic; many very fine and fine roots; many, very fine, tubular pores; medium acid (pH 5.7); abrupt, wavy boundary.

B1--8 to 12 inches, pale-brown (10YR 6/3) light sandy clay loam; when moist, mixed yellowish red (5YR 5/8) and yellowish brown (10YR 5/4); massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine, tubular pores; very strongly acid (pH 4.5); clear, wavy boundary.

B21t--12 to 18 inches, light-red (2.5YR 6/6) heavy clay loam, yellowish red (5YR 4/8) moist; massive; hard, firm, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine, tubular pores; common thin clay films in pores; extremely acid (pH 4.3); abrupt, wavy boundary.

B22t--18 to 43 inches, light-red (2.5YR 6/6) clay, red (2.5YR 5/8) moist; massive; hard, firm, sticky and plastic; a few medium and coarse roots and a few very fine roots; many, very fine, tubular pores; many moderately thick clay films as bridges and in pores; extremely acid (pH 4.3); gradual, smooth boundary.

C1--43 to 54 inches, light reddish-brown (2.5YR 6/4) heavy clay loam, yellowish red (5YR 5/8) moist; massive; hard, firm, slightly sticky and plastic; a few coarse and medium roots; many, very fine, tubular pores; many moderately thick clay films as bridges and in pores; extremely acid (pH 4.3); clear, smooth boundary.

C2--54 to 62 inches, reddish-yellow (5YR 7/6) heavy clay loam, yellowish red (5YR 5/8) moist; massive; hard, firm, slightly sticky and plastic; a few coarse and very fine roots; a few, very fine, tubular pores and many, very fine, interstitial pores; many moderately thick and thick clay films as bridges and in pores; extremely acid (pH 4.3); gradual, smooth boundary.

C3--62 to 72 inches, mottled light-red (2.5YR 6/6) and light-gray (10YR 7/2) sandy clay loam, reddish yellow (5YR 6/8) moist; massive; hard, firm, slightly sticky and slightly plastic; a few coarse roots; common, very fine, tubular and interstitial pores; common moderately thick and thick clay films in pores and as bridges; extremely acid (pH 4.3).

The A horizon ranges from very pale brown to light brown in color, from 6 to 30 inches in thickness, and from sandy loam to sandy clay loam in texture. Texture tends to become more clayey as depth increases. The B horizon ranges in color from very pale brown or light reddish brown to light red, dry, and from yellowish red and yellowish brown to red, moist. This horizon ranges from sandy clay loam to clay or sandy clay. There is 0 to 15 percent water-worn gravel, by volume, throughout the profile.

Included in mapping are small areas of Blucher loam, Cotati fine sandy loam, Goldridge fine sandy loam, and Pajaro fine sandy loam.

Permeability is moderately slow in the subsoil of this Sebastopol soil. Runoff is medium, and the hazard of erosion is moderate. Fertility is moderate. The available water capacity is 8 to 10 inches.

This soil is used mainly for apple orchards and for hay production. There are also a few fields of dryland and irrigated pasture. Capability unit IVe-1.

Sebastopol sandy loam, 2 to 9 percent slopes (SbC).--This soil is similar to Sebastopol sandy loam, 9 to 15 percent slopes, but the surface layer ranges from 18 to 30 inches in thickness. It occurs on broad ridgetops and sloping benches.

Included in mapping are small areas of Blucher loam, Cotati fine sandy loam, and Goldridge fine sandy loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for apple orchards. Some small areas are used for pasture. Capability unit IIIe-1.

Sebastopol sandy loam, 9 to 15 percent slopes, eroded (SbD2).--This soil is similar to Sebastopol sandy loam, 9 to 15 percent slopes, but the surface layer is 6 to 18 inches thick. There has been soil loss resulting from sheet and gully erosion.

Included in mapping are small areas of Cotati fine sandy loam and Goldridge fine sandy loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

The soil is used mainly for apple orchards and for range. Capability unit IVe-1; range site 2.

Sebastopol sandy loam, 15 to 30 percent slopes (SbE).--This soil is similar to Sebastopol sandy loam, 9 to 15 percent slopes.

Included in mapping are small areas of Cotati fine sandy loam and Goldridge fine sandy loam. Also included are a few areas of soil that have slopes of more than 30 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Most of this soil is used for pasture. Some of the lower slopes are used for apple orchards. Capability unit VIe-1; range site 2.

Sheridan Series

The Sheridan series consists of well-drained coarse sandy loams underlain, at a depth of 36 to 60 inches, by granodiorite and weathered, decomposed, granitic material. These soils are on uplands. They are on the coast on Bodega Head, west of Bodega Bay. Slopes are 2 to 30 percent. Elevation ranges from 100 to 300 feet. Annual rainfall is 30 to 35 inches, annual temperature is 56° to 58° F., and the frost-free season is 320 to 340 days. The vegetation is chiefly annual grasses, lupine, forbs, and small brush. The Sheridan soils are associated with the Baywood soils and the land type Dune land.

In a typical profile the soil is very dark grayish-brown and dark-brown, medium acid coarse sandy loam about 47 inches thick. Below this is weathered granodiorite.

Sheridan soils are used mainly for recreation.

Sheridan coarse sandy loam, 2 to 30 percent slopes (SeE).--This gently sloping to moderately steep soil is on uplands. Most of the slopes are long and range from 7 to 15 percent.

Typical profile 3,100 feet due north of the southernmost tip of Bodega Head and 650 feet due west of beach escarpment (NW1/4 NW1/4 sec. 3, T. 6 N., R. 11 W., projected.):

A11--0 to 6 inches, very dark grayish-brown (10YR 3/2) coarse sandy loam, very dark brown (10YR 2/2) moist; moderate, fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; medium acid (pH 6.0); clear, smooth boundary.

A12--6 to 22 inches, very dark grayish-brown (10YR 3/2) coarse sandy loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine roots; common, fine, interstitial pores; medium acid (pH 6.0); gradual, smooth boundary.

A13--22 to 39 inches, very dark grayish-brown (10YR 3/2) coarse sandy loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; common, fine, interstitial pores and a few, fine, tubular pores; medium acid (pH 6.0); gradual, smooth boundary.

A14--39 to 47 inches, dark-brown (10YR 3/3) coarse sandy loam, very dark brown (10YR 2/2) moist; weak, medium, granular structure; soft, very friable, nonsticky and nonplastic; a few very fine and fine roots; common, fine, interstitial pores and a few, fine, tubular pores; medium acid (pH 6.0); abrupt, smooth boundary.

C--47 inches, pale-brown (10YR 6/3) and very pale brown (10YR 7/3) weathered granodiorite, yellowish brown (10YR 5/4) moist; a few very fine roots; medium acid (pH 6.0).

The A horizon ranges from dark brown to very dark gray to very dark grayish brown in color. Bedrock is at a depth of 36 to 60 inches.

Included in mapping are small areas of Baywood loamy sand and Dune land. Also included are areas that are 20 to 36 inches deep to the parent material.

Permeability is moderately rapid in this Sheridan soil. Runoff is slow to rapid, and the hazard of erosion is slight to high. Fertility is moderate. The available water capacity is 3.5 to 7 inches.

This soil is on Bodega Head and on the coast where there is an ideal view of the ocean. It is used mainly for recreation. Capability unit VIe-4.

Sites Series

The Sites series consists of well-drained loams that have a clay subsoil. They are underlain, at a depth of 30 to more than 60 inches, by sandstone and shale. These soils are on mountainous uplands in the north-central and eastern parts of the county. Slopes are 5 to 50 percent. Elevation ranges from 600 to 3,000 feet. Annual rainfall is 25 to 70 inches, annual temperature is 52° to 56° F., and the frost-free season is 260 to 280 days. In most places the vegetation is chiefly Douglas-fir, redwood, madrone, oak, and associated shrubs. Areas that have been logged, however, are sparsely covered with grass and brackenfern. The sites soils are associated with the Boomer, Hugo, Josephine, and Red Hill soils.

In a typical profile the surface layer is medium acid dark-brown loam about 3 inches thick. The subsoil is about 41 inches of medium acid brown clay loam, strongly acid reddish-brown clay, and very strongly acid yellowish-red clay. It is underlain by very strongly acid yellowish-red clay loam. Weathered sandstone is at a depth of about 55 inches.

Sites soils are used mainly for producing timber, chiefly Douglas-fir and redwood. A few areas that have been logged are used for limited grazing by sheep and cattle.

Sites loam, 5 to 30 percent slopes (SfE).--This soil is not extensive. In a few areas it is gently sloping, but generally slopes range from strongly sloping to moderately steep.

Typical profile in an area near Warm Springs Creek Road; on a convex, west-northwest facing

slope of 18 percent; 13 miles west-northwest of Healdsburg (NE1/4 SE1/4 sec. 32, T. 10 N., R. 11 W.); the profile was dry when examined:

A1--0 to 3 inches, dark-brown (7.5YR 4/2) loam, dark reddish brown (5YR 3/3) moist; moderate, fine and medium, subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; common fine roots; common, fine and medium, tubular and interstitial pores; medium acid (pH 6.0); gradual, wavy boundary.

B1--3 to 9 inches, brown (7.5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and plastic; a few fine, medium, and coarse roots; many, very fine and fine, tubular and interstitial pores; a few thin clay films in pores and as colloidal stainings; medium acid (pH 6.0); clear, smooth boundary.

B21t--9 to 16 inches, reddish-brown (5YR 5/4) clay, yellowish red (5YR 4/6) moist; moderate, medium and coarse, subangular blocky structure; very hard, friable, slightly sticky and plastic; a few fine and medium roots; common, very fine and fine, tubular and interstitial pores; many thin clay films in pores and on ped faces; strongly acid (pH 5.5); gradual, smooth boundary.

B22t--16 to 44 inches, yellowish-red (5YR 4/6) clay, dark red (2.5YR 3/6) moist; weak, coarse, subangular blocky structure; very hard, firm, slightly sticky and plastic; a few coarse, fine, and medium roots; a few, very fine and fine, tubular pores; continuous moderately thick clay films in pores and on ped faces; very strongly acid (pH 5.0); 10 percent gravel; diffuse, irregular boundary.

C--44 to 55 inches, yellowish-red (5YR 4/7) clay loam, dark red (2.5YR 3/6) moist; massive; hard, firm, slightly sticky and slightly plastic; a few fine, medium, and coarse roots; a few, very fine and fine, tubular pores; continuous thick clay films on rock faces; very strongly acid (pH 5.0); diffuse boundary.

R--55 inches, weathered metamorphosed sandstone.

The color of the A horizon is brown, dark brown, or reddish brown. The B horizon is brown, yellowish red, reddish brown, or red. Soil depth ranges from 48 to more than 60 inches. The gravel content varies from 0 to 15 percent, by volume, throughout the soil profile.

Included in mapping are small areas of Boomer loam, Hugo very gravelly loam, Josephine loam, and Red Hill clay loam.

Permeability is moderately slow in this Sites soil. Runoff is slow to rapid, and the hazard of erosion is slight to high. Fertility is moderate. The available water capacity is 7 to 10 inches.

This soil is used mainly for producing timber. Some areas have been cleared and are used for limited range. Capability unit VIe-1; woodland group 1.

Sites loam, 30 to 50 percent slopes (SfF).--This soil is similar to Sites loam, 5 to 30 percent slopes, but it is steeper. Most of this Sites soil is on uplands. Depth to bedrock is 30 to 40 inches.

Included in mapping are small areas of Boomer loam, Hugo very gravelly loam, and Josephine loam. Also included are some areas that contain 20 to 30 percent gravel and rock fragments throughout the solum.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 6.5 inches.

This soil is used mainly for producing timber. Some areas that have been cleared are used for very limited grazing. Capability unit VIIe-1; woodland group 7.

Sobrante Series

The Sobrante series consists of well-drained loams that have a clay loam subsoil. They are underlain, at a depth of 20 to 40 inches, by andesitic basalt. These soils are on rolling uplands. They are mainly in the east-central third of the county extending southerly to Sonoma Valley. Slopes are 15 to 75 percent. Elevation ranges from 500 to 2,500 feet. Annual rainfall is 30 to 50 inches, annual temperature is 60° to 62° F., and the frost-free season is 240 to 260 days. In most places the vegetation is chiefly annual grasses, forbs, legumes, and frequent patches of hardwoods, mainly oak and manzanita. The understory is made up of small shrubby plants. The Sobrante soils are associated with the Boomer, Goulding, Laughlin, and Suther soils.

In a typical profile the surface layer is reddish-brown, medium acid loam about 7 inches thick. The subsoil is reddish-brown, slightly acid light clay loam. Weathered greenstone is at a depth of about 20 inches.

Sobrante soils are used mainly as range for sheep and cattle. A few areas support small orchards.

Sobrante loam, 30 to 50 percent slopes (ShF).--This steep soil is on uplands.

Typical profile on a slightly eroded hillside; west-facing slope of 45 percent; 3.2 miles northeast of Healdsburg (SW1/4 SE1/4 sec. 14, T. 10 N., R. 9 W.); the profile was dry when examined:

A1--0 to 7 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, friable, sticky and plastic; many very fine roots; many, very fine, interstitial pores and common, very fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary.

B2t--7 to 20 inches, reddish-brown (5YR 4/4) light clay loam, dark reddish brown (5YR 3/4) moist; strong, medium, subangular blocky structure and strong, medium, granular structure; hard, friable, sticky and plastic; common very fine

roots; many, very fine, interstitial pores and common, fine, tubular pores; continuous thin clay films in pores and as bridges; slightly acid (pH 6.5); clear, wavy boundary.

C&R--20 inches, very pale-brown (10YR 7/4) weathered greenstone that has continuous thin and moderately thick dark reddish-brown (2.5YR 3/4) clay films on fracture faces.

The A horizon ranges in color from brown to reddish brown. The B horizon generally is less acid than the A horizon. Depth to weathered greenstone ranges from 20 to 40 inches. Gravel content of shattered rock fragments varies from none to about 10 percent, by volume, because of irregular weathering of the parent bedrock.

Included in mapping are small areas of Boomer loam, Goulding cobbly clay loam, Laughlin loam, and Suther loam. Although rock outcrops are characteristically associated with the landscape, they occupy less than 3 percent of the surface.

Permeability is moderate in this Sobrante soil. Runoff is rapid, and the hazard of erosion is high. Fertility is moderate. The available water capacity is 3.5 to 8 inches.

The soil is used mainly for range. Capability unit VIe-1; range site 4.

Sobrante loam, 15 to 30 percent slopes (ShE).--This soil is similar to Sobrante loam, 30 to 50 percent slopes, but it is not so steep. Soil depth ranges from 20 to 35 inches.

Included in mapping are small areas of Boomer loam, Goulding cobbly clay loam, and Laughlin loam. Areas that have been cultivated or heavily grazed are eroded, occasionally exposing the redder subsoil.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 3.5 to 7 inches.

This soil is used mainly for range. A few areas have been cultivated and are used for small family orchards. Capability unit IVe-1; range site 4.

Sobrante loam, 50 to 75 percent slopes (ShG).--This soil is similar to Sobrante loam, 30 to 50 percent slopes, but it is steeper. Soil depth ranges from 20 to 30 inches.

Included in mapping are small areas of Boomer loam, Goulding cobbly clay loam, and Laughlin loam. Some areas are eroded, exposing the reddish-brown subsoil.

Runoff is very rapid, and the hazard of erosion is very high. The available water capacity is 3.5 to 6 inches.

This soil is used mainly for range. Capability unit VIIe-1; range site 8.

Spreckels Series

The Spreckels series consists of well-drained loams that have a clay subsoil. They are underlain, at a depth of 22 to 60 inches, by volcanic tuffs mixed with uplifted river sediment and weathered, basic igneous rock. These soils are on terraces and mountainous uplands. They are mainly in the range of hills that extends along the west side of the Valley of the Moon from southeast of Healdsburg to southeast of Santa Rosa. Slopes are 2 to 50 percent. Elevation ranges from 300 to 2,000 feet. Annual rainfall is 25 to 35 inches, annual temperature is 59° to 62° F., and the frost-free season is 280 to 300 days. In most places the vegetation is chiefly white oak and black oak, madrone, poison oak, manzanita, and annual and perennial grasses. The Spreckels soils are associated with the Felta, Laniger, and Toomes soils.

In a typical profile the surface layer is grayish-brown loam and light brownish-gray clay loam. This layer is slightly acid and about 18 inches thick. The subsoil is brown and pale-brown, strongly acid clay about 19 inches thick. The substratum, consisting of cemented tuff and very gravelly clay loam, is at a depth of about 37 inches.

Spreckels soils are used mainly as range and pasture for sheep and cattle. A few small cleared areas are used for vineyards and prune orchards or as irrigated pasture.

Spreckels loam, 15 to 30 percent slopes (SkE).--This moderately steep soil is on uplands. Most of the slopes are short and abrupt, and slope ranges from 18 to 25 percent in most places.

Typical profile in a thicket supporting white oak; north-facing, slightly concave slope of 28 percent; 1 mile east of the junction of Leslie Road and Chalk Hill Road on the Faught ranch (NE1/4 NW1/4 sec. 16, T. 8 N., R. 8 W.); the profile was moist throughout when examined:

A11--0 to 9 inches, grayish-brown (10YR 5/2) loam, very dark gray (10YR 3/1) moist; moderate, fine and medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common, fine, tubular pores and many, very fine and fine, interstitial pores; slightly acid (pH 6.5); clear, smooth boundary.

A12--9 to 18 inches, light brownish-gray (10YR 6/2) clay loam, very dark grayish-brown (10YR 3/2) moist; moderate, medium and coarse, subangular blocky structure; hard, friable, sticky and plastic; common coarse, medium, and fine roots; common, fine, tubular pores and many, very fine and fine, interstitial pores; slightly acid (pH 6.5); abrupt, smooth boundary.

B21t--18 to 29 inches, brown (10YR 5/3) clay, dark yellowish brown (10YR 4/4) and dark brown (10YR 4/3) moist; massive; very hard, very firm, sticky and very plastic; common coarse roots; common, very fine, discontinuous, tubular pores; continuous thick clay films as bridges and in pores; thin discontinuous bleached capping on horizon; strongly acid (pH 5.5); gradual, wavy boundary.

B22t--29 to 37 inches, brown (10YR 5/3) and pale-brown (10YR 6/3) clay, dark brown (10YR 4/3) moist; massive; extremely hard, firm, sticky and plastic; a few very fine and fine roots and common coarse roots; common very fine pores; continuous moderately thick clay films in pores and as bridges; strongly acid (pH 5.5); clear, wavy boundary.

C--37 inches, brown (10YR 5/3) and yellowish-brown (10YR 5/6) weakly to strongly cemented tuff and very gravelly clay loam, dark yellowish brown (10YR 4/4) moist; massive; traces of clay films along gravel contacts; medium acid (pH 5.7).

The A horizon is from 18 to 26 inches thick, and is light brownish gray to gray or grayish brown. Gravel content ranges from none to about 20 percent, by volume. The Bt horizon ranges from 18 to 34 inches thick and from brown to grayish brown to light gray or pale brown, dry. Generally, the B horizon has a distinct spreckled appearance because of decomposed and scattered light-colored andesitic basalt fragments and tuffaceous sediment. Where this soil becomes mixed with the Toomes or Suther soils, the speckling of the B horizon is less noticeable.

Included in mapping are areas of Felta very gravelly loam, Laniger loam, Suther loam, and Toomes loam. Also included are some areas that have rock outcrops.

Permeability is slow in this Spreckels soil. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is moderate. The available water capacity is 5 to 9 inches. The effective rooting depth is 36 to 60 inches.

This soil is used mainly for range and pasture. Capability unit VIe-3; range site 2.

Spreckels loam, 2 to 9 percent slopes (SkC).--This soil is similar to Spreckels loam, 15 to 30 percent slopes, but it is not so steep. Frequently, the surface layer is shallower on the low slopes, ridgetops, or lower ends of footslopes. Depth to the subsoil is only 14 to 22 inches.

Included in mapping are small areas of Felta very gravelly loam, Laniger loam, Toomes loam, and a few areas that have rock outcrops. Scattered gravel patches may be found in the surface layer of soils on the lower slopes.

Runoff is medium, and the hazard of erosion is slight. The available water capacity is 4.5 to 7.5 inches. The effective rooting depth is about 30 to 48 inches.

Most of this soil is used for pasture. Where water is available, there are some irrigated pastures. Capability unit IIIe-3.

Spreckels loam, 9 to 15 percent slopes (SkD).--This soil is similar to Spreckels loam, 15 to 30 percent slopes, but it is not so steep. The surface layer is 14 to 22 inches thick.

Included in mapping are small areas of Felta very gravelly loam, Laniger loam, Toomes loam, and a few areas that have rock outcrops.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 3 to 9 inches. The effective rooting depth is 22 to 56 inches.

This soil is used for dryland and irrigated pasture. Capability unit IVe-3; range site 2.

Spreckels loam, 15 to 30 percent slopes, eroded (SkE2).--This soil has been subjected to overuse, and the surface layer has been removed by sheet and gully erosion. Depth to the subsoil is 12 to 22 inches.

Included in mapping are small areas of Felta very gravelly loam, Laniger loam, Toomes loam, and a few areas that have rock outcrops.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 3 to 9 inches. The effective rooting depth is 22 to 56 inches.

This soil is used mainly for range. Capability unit VIe-3; range site 2.

Spreckels loam, 30 to 50 percent slopes (SkF).--This soil is similar to Spreckels loam, 15 to 30 percent slopes, but is steeper.

Included in mapping are small areas of Felta very gravelly loam, Laniger loam, Suther loam, Toomes loam, and a few areas that have rock outcrops. Pieces of basaltic float rock, 5 to 20 inches in diameter, are occasionally present in the soil and on the surface.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4.5 to 7.5 inches. The effective rooting depth is 28 to 50 inches.

This soil is limited in its usefulness for grazing, as wildlife habitat, and for watershed purposes. Capability unit VIe-3; range site 6.

Steinbeck Series

The Steinbeck series consists of moderately well drained loams that have a subsoil of mainly clay loam. They are underlain, at a depth of 20 to more than 60 inches, by weakly to moderately consolidated sandstone and shale. These undulating, gently sloping to steep soils are on dissected marine terraces. They are mainly in the southwestern part of the county west of Petaluma and along the coast. Slopes are 2 to 50 percent. Elevation ranges from 400 to 1,000 feet. Annual rainfall is 20 to 35 inches, annual temperature is 53° to 55° F., and the frost-free season is 250 to 270 days. In most places the vegetation is chiefly annual and perennial grasses, forbs, shrubs, and a few scattered oak trees. The Steinbeck soils are associated with the Cotati, Goldridge, Los Osos, and Pajaro soils.

In a typical profile the surface layer is dark-gray, strongly acid loam about 18 inches thick. The subsurface layer is gray and light-gray, strongly acid fine sandy loam about 17 inches thick. The subsoil is light yellowish-brown, medium acid light clay loam. At a depth of about 56 inches is weakly cemented sandstone.

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Steinbeck soils are used mainly for pasture and range for sheep and dairy cows. Some areas are used for the production of grain and hay crops. Occasionally, corn fields are planted for silage.

Steinbeck loam, 9 to 15 percent slopes (SnD).--This soil is on rolling rounded marine terraces.

Typical profile in an improved pasture in good condition; slightly concave, west-facing slope of 9 percent; 390 feet south of Valley Ford Road and 5,180 feet west of the junction of Freestone and Valley Ford Roads (NE1/4 NE1/4 sec. 34, T. 6 N., R. 10 W.); the profile was dry to a depth of 35 inches when examined:

A11--0 to 8 inches, dark-gray (10YR 4/1) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common, very fine and fine, interstitial and tubular pores; common worm casts; strongly acid (pH 5.5); clear, wavy boundary.

A12--8 to 18 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; weak, very fine, subangular blocky and fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine fibrous roots; common, very fine and fine, interstitial and tubular pores; many worm casts; strongly acid (pH 5.5); gradual, wavy boundary.

A21--18 to 28 inches, gray (10YR 5/1) fine sandy loam that has some A1 material mixed in by worm activity; when moist, dark grayish brown (10YR 4/2) and having very dark grayish brown (10YR 3/2) worm casts; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many, very fine and fine, interstitial and tubular pores; many worm casts; strongly acid (pH 5.5); gradual, wavy boundary.

A22--28 to 35 inches, light-gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) to yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, nonsticky and nonplastic; many very fine and fine roots; many, very fine and fine, interstitial and tubular pores; a few worm tubes and casts; strongly acid (pH 5.5); clear, wavy boundary, abrupt in some areas and clear in others.

B21t--35 to 45 inches, light yellowish-brown (10YR 6/4) light clay loam that has common, medium, distinct yellowish-brown mottles; when moist, yellowish brown (10YR 5/6) and having strong-brown mottles; weak, very coarse, prismatic structure; hard, very firm, sticky and plastic; many very fine and fine roots; many, very fine, tubular pores; continuous thin and moderately thick clay films on ped faces and moderately thick clay films in pores; a few, small, iron and manganese concretions; medium acid (pH 5.8); gradual, wavy boundary.

B22t--45 to 56 inches, light yellowish-brown (10YR 6/4) light clay loam that has common, medium, distinct yellowish-brown mottles; when moist, yellowish brown (10YR 5/6) and having strong-brown mottles; weak, coarse, prismatic structure; hard, very firm, very sticky and very plastic; common fine and very fine roots; many, very fine, tubular pores; continuous moderately thick clay films on ped faces and in pores; medium acid (pH 6.0); abrupt, wavy boundary.

C--56 inches, light-gray (2.5Y 7/2) sandstone that has many fine distinct strong-brown (7.5YR 5/8) mottles and streaks; when moist, light brownish gray (2.5Y 6/2) and having yellowish-brown and strong-brown streaks and mottles; massive, weakly consolidated; brittle lenses or nodular lumps interspersed with friable material; thick clay films in the few fissures and fractures in the weakly consolidated sandstone; slightly acid (pH 6.5); a few fossil imprints.

The A horizon ranges from light gray to dark grayish brown or dark gray in color and from sandy loam to silt loam in texture. This horizon is from 20 to 48 inches thick. The B horizon ranges from sandy clay loam to light clay loam. Colors are gray, pale olive, pale brown, and light yellowish brown with strong-brown or yellowish-brown mottles. Frequently the B horizon appears to rest on a weakly and irregularly consolidated siltstone or sandstone without a C1 horizon. The C horizon is pink, grayish-brown, gray, light-gray, or reddish-yellow sandy clay loam or sandy loam. Material in this horizon is frequently mixed with the consolidated underlying sandstone. Depth to the weakly to moderately consolidated sedimentary rock ranges from about 30 to more than 60 inches.

Included in mapping are small areas of Cotati fine sandy loam, Goldridge fine sandy loam, Los Osos clay loam, and Pajaro fine sandy loam.

Permeability is moderate in this Steinbeck soil. Runoff is medium, and the hazard of erosion is moderate. Fertility is moderately high. The available water capacity is 5 to 10 inches. The effective rooting depth is 30 to 60 inches.

This soil is used mainly as range or pasture for sheep and dairy cows. Some areas are used for producing grain and hay. Capability unit IVe-1; range site 1.

Steinbeck loam, 2 to 9 percent slopes (SnC).--This soil is similar to Steinbeck loam, 9 to 15 percent slopes, but is not so steep. Because of its lower topographic position, this soil is slightly deeper than the typical soil of this series. Soil depth generally is 45 to more than 60 inches. In places on the lower footslopes, however, internal drainage problems resulting from subsoil water movement downslope cause wetness and seeps late in the season. This delays the planting of crops and pasture cover.

Included in mapping are small areas of Cotati fine sandy loam, Goldridge fine sandy loam, and Pajaro fine sandy loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 7.5 to 10 inches. The effective rooting depth is 45 to 60 inches.

This soil is used mainly for pasture and the production of grain, hay, and field corn for silage. Where water is available, pastures are irrigated. Capability unit IIIe-1.

Steinbeck loam, 9 to 15 percent slopes, eroded (SnD2).--This soil is similar to Steinbeck loam, 9 to 15 percent slopes, but sheet and gully erosion have occurred on it in places. Depth to the subsoil generally is 16 to 30 inches. Wet spots and seeps are present in some of the lower toe slopes.

Included in mapping are small areas of Cotati fine sandy loam, Goldridge fine sandy loam, and Los Osos clay loam.

The available water capacity is 5 to 8 inches. The effective rooting depth is 30 to 45 inches.

These soils are used mainly for pasture and range. If carefully managed, they can be cultivated for the production of grain and hay. Capability unit IVe-1; range site 1.

Steinbeck loam, 15 to 30 percent slopes (SnE).--This soil is similar to Steinbeck loam, 9 to 15 percent slopes, but it is steeper, and the surface layer generally is thinner. The thickness of the combined surface layer and subsoil generally is 30 to 40 inches.

Included in mapping are small areas of Cotati fine sandy loam, Goldridge fine sandy loam, and Los Osos clay loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 5 to 7.5 inches. The effective rooting depth is 30 to 40 inches.

This soil is used mainly for range and pasture. Capability unit VIe-1; range site 1.

Steinbeck loam, 15 to 30 percent slopes, eroded (SnE2).--This soil is similar to Steinbeck loam, 15 to 30 percent slopes, but it is eroded. The soil is 24 to 40 inches deep over weakly consolidated sandstone. Overgrazing and, in some cases, poor methods of cultivation have contributed to erosion damage.

Included in mapping are small areas of Cotati fine sandy loam, Goldridge fine sandy loam, and Los Osos clay loam.

Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 4 to 7.5 inches. The effective rooting depth is 24 to 40 inches.

This soil is used mainly for range and pasture. Capability unit VIe-1; range site 1.

Steinbeck loam, 30 to 50 percent slopes (SnF).--This soil is similar to Steinbeck loam, 9 to 15 percent slopes, but it is steeper and depth to the substratum is only about 25 to 35 inches.

Included in mapping are small areas of Goldridge fine sandy loam and Los Osos clay loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is 4 to 6.5 inches. The effective rooting depth is 25 to 35 inches.

This soil is used mainly for range. Capability unit VIe-1; range site 5.

Steinbeck loam, 30 to 50 percent slopes, eroded (SnF2).--This soil is similar to Steinbeck loam, 9 to 15 percent slopes, but it is steeper and is eroded. In places the pale-brown subsoil is at or near the surface. Deep gullies are common.

Included in mapping are small areas of Goldridge fine sandy loam and Los Osos clay loam.

Runoff is rapid, and the hazard of erosion is high. The available water capacity is about 3.5 to 5.5 inches. The effective rooting depth is 20 to 30 inches.

This soil is used mainly for limited grazing. It is also used as watershed. Capability unit VIe-1; range site 5.

Stonyford Series

The Stonyford series consists of somewhat excessively drained gravelly loams that have a very gravelly clay loam subsoil. They are underlain, at a depth of 12 to 22 inches, by weathered greenstone and basic igneous rock. These soils are on mountainous uplands, mainly in the north-central and northeastern parts of the county. Slopes are 30 to 75 percent. Elevation ranges from 800 to 3,000 feet. Annual rainfall is 30 to 60 inches, annual temperature is 57° to 59° F., and the frost-free season is 260 to 280 days. In most places the vegetation is chiefly chamise, Toyon, buckbrush, poison oak, and other small shrubs and brush, but a few areas have a sparse cover of grass and shrub oak. The Stonyford soils are associated with the Goulding, Henneke, Laughlin, and Los Gatos soils.

In a typical profile the surface layer is reddish-brown, slightly acid gravelly loam about 5 inches thick. The subsoil is reddish-brown, slightly acid gravelly clay loam and very gravelly clay loam about 14 inches thick. Fractured greenstone that has clay loam in the cracks is at a depth of about 19 inches.

Stonyford soils are used mainly for wildlife browse, recreation, and as watershed. A few grassy areas are used for limited grazing by sheep and cattle.

Stonyford gravelly loam, 50 to 75 percent slopes (SoG).--This very steep soil is on uplands.

Typical profile 7.5 miles north-northeast of Healdsburg; southwest-facing slope of 60 percent; (SE1/4 sec. 14; T. 10 N., R. 8 W.); the profile was moist below a depth of 5 inches when examined:

A1--0 to 1 inch, reddish-brown (5YR 5/4) gravelly loam, dark reddish brown (5YR 3/4) moist; strong, very fine, granular structure; soft,

very friable, nonsticky and nonplastic; slightly acid (pH 6.3); abrupt, smooth boundary.

A3--1 to 5 inches, reddish-brown (5YR 5/4) gravelly loam, dark reddish brown (5YR 3/3) moist; moderate, medium and coarse, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine roots and many medium and coarse roots; common, fine, tubular pores; many thin clay films in pores and as bridges; slightly acid (pH 6.5); clear, smooth boundary.

B21t--5 to 12 inches, reddish-brown (5YR 4/4) gravelly clay loam, dark reddish brown (5YR 3/4) moist; moderate, medium and coarse, subangular blocky structure; hard, friable, sticky and plastic; a few coarse roots, common fine roots, and many medium roots; many micro pores and common, very fine, tubular pores; many moderately thick clay films in pores, on ped faces, and in rock interstices; slightly acid (pH 6.5); clear, wavy boundary.

B22t--12 to 19 inches, reddish-brown (2.5YR 4/4) very gravelly clay loam, dark reddish brown (2.5YR 3/4) moist; moderate, medium and coarse, subangular blocky structure; hard, friable, sticky and plastic; a few fine, medium, and coarse roots; many very fine pores and common, fine, tubular pores; strong-brown (7.5YR 5/6) and reddish-yellow (7.5YR 6/6) thick and moderately thick clay films in rock interstices; slightly acid (pH 6.5); clear, wavy boundary.

R--19 inches, fractured greenstone that has clay loam in cracks.

The B21t horizon contains 0 to 10 percent stones and 15 to 25 percent gravel. The B22t horizon contains 5 to 20 percent stones and 25 to 40 percent gravel. Depth to greenstone ranges from 12 to 22 inches.

Included in mapping are small areas of Goulding cobbly clay loam, Henneke gravelly loam, Laughlin loam, and Los Gatos gravelly loam. Also included are areas of a soil that is deeper than 22 inches, and areas of a soil that has a gravelly clay subsoil.

Permeability is moderate in this Stonyford soil. Runoff is very rapid, and the hazard of erosion is very high. Fertility is very low. The available water capacity is 1.5 to 3 inches.

This soil is used for limited grazing, for wildlife browse and cover, and as watershed. Capability unit VIIe-8; range site 10.

Stonyford gravelly loam, 30 to 50 percent slopes (SoF).--This soil is similar to Stonyford gravelly loam, 50 to 75 percent slopes, but it is not so steep, and the surface layer generally is 2 to 4 inches thicker. The average depth to bedrock ranges from 15 to 22 inches.

Included in mapping are small areas of Goulding cobbly clay loam, Henneke gravelly loam, Laughlin loam, and Los Gatos gravelly loam. Also included are areas of a soil that is 30 inches deep to rock.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for limited range. It is also used for wildlife browse and cover and as watershed. Capability unit VIIe-8; range site 10.

Stonyford-Boomer complex, 30 to 75 percent slopes (SrG).--This complex is in the northern half of the county in the hills along the Russian River Valley. Stonyford soils make up about 65 percent of the complex, and Boomer soils about 35 percent. Generally, the Stonyford soils have slopes that face south and southeast and the deeper Boomer soils have slopes that face north and northeast. Brush cover dominates the Stonyford soils. There are some conifers and hardwood on the Boomer soils. The Stonyford soils are stony in places.

The Stonyford soils have a profile similar to that of Stonyford gravelly loam, 50 to 75 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high.

The Boomer soils have a profile similar to that of Boomer loam, 50 to 75 percent slopes. Runoff is rapid to very rapid, and the hazard of erosion is high.

These soils are used mainly for range and pasture. Capability unit VIIe-8; range site 10.

Supan Series

The Supan series consists of well-drained silt loams that have a clay loam subsoil. They are underlain, at a depth of 30 to 55 inches, by weathered andesitic basalt and hard volcanic breccia. These soils are on mountainous uplands, mainly in the northeastern third of the county. Slopes are 30 to 55 percent. Elevation ranges from 800 to 3,000 feet. Annual rainfall is 30 to 60 inches, annual temperature is 53° to 55° F., and the frost-free season is 240 to 260 days. In most places the vegetation is chiefly grass, oak, small shrubs, and brush. The Supan soils are associated with the Boomer, Guenoc, Sobrante, and Toomes soils.

In a typical profile the surface layer is brown, medium acid silt loam about 8 inches thick. The subsoil is brown silty clay loam and strong-brown and yellowish-brown clay loam. This layer is medium acid and about 31 inches thick. Highly weathered basic igneous rock occurs at a depth of about 39 inches.

Supan soils are used mainly for range and pasture.

Supan silt loam, 30 to 75 percent slopes (SsG).--This steep and very steep soil is on uplands. In most places the slope ranges from 30 to 50 percent.

Typical profile 2.5 miles north of Geyserville (SW1/4 sec. 6. T. 10 N., R. 9 W.):

A1--0 to 8 inches, brown (7.5YR 5/4) silt loam, dark brown (7.5YR 4/2, 3/2) moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and plastic;

many very fine roots; medium acid (pH 6.0); diffuse boundary.

B1t--8 to 19 inches, brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/2, 3/2) moist; weak, medium, subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and medium roots; medium acid (pH 6.0); gradual, smooth boundary.

B21t--19 to 29 inches, strong-brown (7.5YR 5/6) clay loam, brown (7.5YR 5/4) moist; weak, medium and coarse, subangular blocky structure; hard, firm, slightly sticky and plastic; a few very fine roots; many, fine and medium, tubular pores and a few, fine, interstitial pores; many moderately thick clay films on peds and in pores; medium acid (pH 6.0); gradual, smooth boundary.

B22t--29 to 39 inches, yellowish-brown (10YR 5/4) clay loam; when moist, brown (10YR 5/3) and having common, fine, distinct yellowish-red (5YR 4/6) mottles; massive; very hard, extremely firm, slightly sticky and very plastic; a few medium roots; many, fine and medium, tubular pores and a few, fine, interstitial pores; common moderately thick clay films in pores; medium acid (pH 6.0); clear, irregular boundary.

R--39 inches, highly weathered basic igneous rocks; massive; friable; slightly acid (pH 6.5).

The A horizon ranges from brown to dark brown in color and from silt loam to clay loam in texture. The B horizon is brown and strong brown to yellowish brown or dark yellowish brown. The soils are generally medium acid throughout, but in places they are slightly acid to neutral in the lower B horizon. Depth to bedrock ranges from 30 to 55 inches.

Included in mapping are small areas of Boomer loam, Guenoc gravelly silt loam, Sobrante loam, Toomes loam, and a few areas that have rock outcrops.

Permeability is moderately slow in this Supan soil. Runoff is rapid to very rapid, and the hazard of erosion is high to very high. Fertility is moderate. The available water capacity is 5 to 10 inches.

This soil is used mainly for range and pasture. Capability unit VIIe-1; range site 5.

Suther Series

The Suther series consists of moderately well drained loams that have a gravelly clay subsoil. They are underlain, at a depth of 18 to 40 inches, by sandstone. These soils are on mountainous uplands, mainly across the northern half of the county. Slopes are 15 to 75 percent. Elevation ranges from 600 to 3,000 feet. Annual rainfall is 30 to 70 inches, annual temperature is 52° to 54° F., and the frost-free season is 240 to 260 days. In most places the vegetation is chiefly mixed annual and perennial grasses, legumes, oak trees, and small shrubs. The Suther soils are associated with the Hugo, Josephine, Laughlin, and Yorkville soils.

In a typical profile the surface layer is pale-brown, medium acid loam about 3 inches thick. The subsoil is pale-brown, medium acid clay loam and medium and strongly acid gravelly clay. Weathered and shattered sandstone is at a depth of about 36 inches.

Suther soils are used mainly for grazing by sheep and cattle.

Suther loam, 15 to 30 percent slopes (StE).--This moderately steep soil is on uplands. Most of the slopes are long and smooth, and in most places they range from 18 to 25 percent.

Typical profile 3 1/2 miles west-northwest of Kellogg (SW1/4 sec. 35, T. 10 N., R. 8 W.); the profile was dry when examined:

A1--0 to 3 inches, pale-brown (10YR 6/3) loam, very dark brown (10YR 2/2) moist; weak, fine, subangular blocky structure; hard, friable, nonsticky and nonplastic; many very fine roots; many, very fine and fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary.

B1t--3 to 14 inches, pale-brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; a few fine roots; many, very fine and fine, tubular pores; medium acid (pH 6.0); clear, smooth boundary.

B21t--14 to 24 inches, pale-brown (10YR 6/3) gravelly clay, dark brown (10YR 4/3) moist; massive; very hard, very firm, sticky and very plastic; common, very fine and fine, tubular pores; many moderately thick clay films in pores and as bridges; strongly acid (pH 5.5); diffuse, wavy boundary.

B22t--24 to 36 inches, pale-brown (10YR 6/3) gravelly clay; when moist, yellowish brown (10YR 5/6) and having many, fine, distinct dark grayish-brown (10YR 4/2) mottles; massive; very hard, very firm, sticky and very plastic; common, fine, tubular pores; many moderately thick clay films in pores and as bridges; medium acid (pH 6.0).

C--36 inches, weathered and shattered sandstone.

The A horizon ranges in color from pale brown to grayish brown, and the B horizon from pale brown to strong brown. Generally, the lower part of the B horizon is mottled. The B horizon may be massive or have coarse prismatic and subangular blocky structure. Gravel and sandstone rock fragment content varies from 10 to 35 percent, by volume, throughout the profile. The depth to bedrock generally ranges from 20 to 40 inches.

Included in mapping are small areas of Hugo loam, Josephine loam, Laughlin loam, and Yorkville clay loam.

Permeability is slow in this Suther soil. Runoff is medium, and the hazard of erosion is moderate. Fertility is moderate. The available water capacity is 3 to 7 inches. This soil is subject to landslips.

This soil is used mainly for range. Capability unit VIe-3; range site 2.

Suther loam, 15 to 30 percent slopes, eroded (StE2).--This soil is moderately eroded. It has a profile similar to that of Suther loam, 15 to 30 percent slopes. Gullying and landslips are more common than sheet erosion on this soil. Depth to parent rock is 18 to 30 inches.

Included in mapping are small areas of Hugo loam, Laughlin loam, and Yorkville clay loam.

The available water capacity is 3 to 5 inches.

The soil is used mainly for range. Capability unit VIe-3; range site 2.

Suther loam, 30 to 50 percent slopes (StF).--This soil is similar to Suther loam, 15 to 30 percent slopes, but it is steeper. In places a few gullies and old slips are present, but otherwise little erosion has occurred.

Included in mapping are small areas of Hugo very gravelly loam, Josephine loam, and Laughlin loam.

Runoff is rapid, and the hazard of erosion is high. This soil is subject to landslips.

This Suther loam is used mainly as range, wildlife habitat, and for recreation. Capability unit VIe-3; range site 6.

Suther-Laughlin loams, 15 to 50 percent slopes (SuF).--This complex is on the lower footslopes east of Knights Valley, and areas of it extend northward on the east side of the Alexander Valley and on the northwest and north ranges of the county. Suther soils make up about 60 percent of the complex, Laughlin soils about 35 percent, and Yorkville soils 5 percent. The Suther soils have concave slopes. The Laughlin soils generally are on or near ridgetops. Although the soils are strongly sloping to moderately steep in some areas, in the majority of the areas they are steep. They are on uplands. Some gullies and slips are evident on the Suther soils.

Suther loam has a profile similar to that of Suther loam, 15 to 30 percent slopes. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Laughlin loam has a profile similar to that of Laughlin loam, 50 to 75 percent slopes. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used mainly as range and pasture. Generally, the cover is annual grasses and legumes. Capability unit VIe-3; Suther, range site 6; Laughlin, range site 8.

Suther-Laughlin loams, 50 to 75 percent slopes (SuG).--This complex is similar to Suther-Laughlin loams, 15 to 50 percent slopes, but is steeper. It is on the steeper slopes north of Knights Valley and in areas that are located on the uplands east of the Russian River Valley. Other scattered areas are in the rangelands of the northwestern part of the county between the coast and the Russian River. Suther loam makes up about 60 percent of the complex, Laughlin loam about 35 percent, and Yorkville soils about 5 percent. Some gullying and slips are evident on Suther soils. Included in mapping are small areas of Suther soils that have a clay loam surface layer.

Suther loam has a profile similar to that of Suther loam, 15 to 30 percent slopes. Runoff is very rapid, and the hazard of erosion is very high.

Laughlin loam has a profile similar to Laughlin loam, 50 to 75 percent slopes. Runoff is very rapid, and the hazard of erosion is very high.

These soils are used mainly for range and pasture. Capability unit VIIe-3; Suther, range site 6; Laughlin, range site 8.

Terrace Escarpments

Terrace escarpments (TeG) consist of long, narrow, rocky areas that rise abruptly from the mean tide line to the coastal plain terraces or plateaus. This land type consists of steep faces that separate the terraces from the lower lying land. The faces are composed of soft coastal sandstone, hard shale, or hard, weather-resistant, fine-grained sandstone. Vegetation is sparse and is made up of dwarfed shrubs, a few patches of grass, lichens, and moss. In seepage areas water grasses, a few cypress and oaks, and various weathered conifers also grow.

Areas of Terrace escarpments are used mainly for watershed and as wildlife habitat. Capability unit VIIIs-8.

Tidal Marsh

Tidal marsh (TmA) consists of nearly level marsh lands that are under water or extremely wet throughout the year. This miscellaneous land type occurs adjacent to San Pablo Bay and on narrow drainageways that empty into the Pacific Ocean. Except for small included areas that support limited grazing, Tidal marsh has no farming value. It is used mainly for recreation and as wildlife habitat. Capability unit VIIIw-2.

Toomes Series

The Toomes series consists of well-drained loams underlain, at a depth of 5 to 20 inches, by shattered and weathered andesitic basalt and volcanic breccia. These soils are gently sloping, on ridgetops, to very steep, on mountainous uplands. They are in the eastern hills and mountains in the basaltic lava flow areas of the county. Slopes are 2 to 75 percent. Elevation ranges from 500 to 2,500 feet. Annual rainfall is 30 to 50 inches, annual temperature is 60° to 62° F., and the frost-free season is 250 to 260 days. In most places the vegetation is chiefly sparse annual grass, forbs, coffeeberry, Toyon, other small shrubs, and occasional oak trees. The Toomes soils are associated with the Goulding, Guenoc, Red Hill, and Spreckels soils.

In a typical profile the surface layer is reddish-brown, medium acid loam and dark-brown, slightly acid clay loam about 13 inches thick. Below this is weathered basalt.

Toomes soils are used for limited range for sheep and cattle. Most of the steeper areas are used as wildlife habitat and for watershed.

Toomes rocky loam, 2 to 30 percent slopes (ToE).--This gently sloping to moderately steep soil is on uplands. Most of the slopes are short and abrupt, and in most places, the range is from 15 to 30 percent. Rock outcrops cover 2 to 10 percent of the surface.

Typical profile 2 1/2 miles east of Geyserville (center of sec. 16, T. 10 N., R. 9 W.):

A11--0 to 4 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; medium acid (pH 6.0); diffuse, wavy boundary.

A12--4 to 13 inches, dark-brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/3) moist; massive; hard, firm, sticky and plastic; common fine and very fine roots; slightly acid (pH 6.5); diffuse, wavy boundary.

R--13 inches, weathered and fresh basalt with some soil material.

These soils are loam, silt loam, or light clay loam in texture and reddish brown, brown, dark brown, or grayish brown in color. Depth to bedrock averages 13 inches, but may range from 5 to 20 inches.

Included in mapping are small areas of Goulding cobbly clay loam, Guenoc gravelly silt loam, Red Hill cobbly clay loam, and Spreckels loam. In some places, stones and cobblestones occur on the surface.

Permeability is moderate in this Toomes soil. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Fertility is low. The available water capacity is 1 to 4 inches.

These soils are used mainly for range. Capability unit VIIe-8; range site 9.

Toomes rocky loam, 30 to 75 percent slopes (ToG).--This soil is similar to Toomes rocky loam, 2 to 30 percent slopes, but it is steeper. Hardwoods and shrubs are more prevalent on these steeper hillsides than on the lesser slopes.

Included in mapping are small areas of Goulding cobbly clay loam, Guenoc gravelly silt loam, and Spreckels loam.

Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used mainly as range for sheep and cattle. These steep and very steep hillsides are also used for watersheds. Capability unit VIIe-8; range site 9.

Tuscan Series

The Tuscan series consists of moderately well-drained cobbly clay loams. At a depth of 10 to 25 inches these soils are underlain by an indurated cobbly hardpan composed of material derived mainly from basic igneous sources. These soils are on bench terraces. They generally are in the Sonoma Valley and in the central part of the county on footslopes. Slopes are 0 to 30 percent. Elevation ranges from 200 to 400 feet. Annual rainfall is 25 to 35 inches, annual temperature is 58° to 60° F., and the frost-free season is 250 to 270 days. In most places the vegetation is chiefly annual grasses, forbs, and low-growing shrubs, but there are a few areas of scattered small brush and shrub oak trees. The Tuscan soils are associated with the Clear Lake, Clough, Diablo, and Goulding soils.

In a typical profile the surface layer is grayish-brown, medium acid cobbly clay loam and brown, slightly acid cobbly light clay loam about 9 inches thick. The subsoil is dark-brown, slightly acid very gravelly clay. An indurated cobbly hardpan is at a depth of about 17 inches.

Tuscan soils are used mainly for pasture for sheep and cattle. Some areas, however, are being used for homesites.

Tuscan cobbly clay loam, 0 to 9 percent slopes (TuC).--This soil is on old terraces. Generally, it is gently sloping to rolling, although in a few areas it is nearly level.

Typical profile in a pasture in fair condition; east-facing slope of 6 percent; 0.25 mile west of Windy Corner and 600 feet north of Stage Gulch Road (SW1/4 NW1/4 sec. 26, T. 5 N., R. 6 W.); the profile was moist below a depth of 9 inches when examined:

Ap--0 to 5 inches, grayish-brown (10YR 5/2) cobbly clay loam that has common, fine, distinct, light brownish-gray and dark-brown mottles; when moist, very dark brown (7.5YR 2/2); massive; hard, friable, slightly sticky and plastic; common very fine roots; many, very fine, tubular pores; thin moss layer on surface; medium acid (pH 6.0); clear, smooth boundary.

A1--5 to 9 inches, brown (7.5YR 4/2) cobbly light clay loam, very dark brown (7.5YR 2/2) moist: massive; hard, friable, slightly sticky and plastic; a few very fine roots; many, very fine and fine, tubular pores; slightly acid (pH 6.3); clear, smooth boundary.

B2t--9 to 17 inches, dark-brown (7.5YR 4/2) very gravelly clay that has common, fine, distinct, strong-brown (7.5YR 6/5) mottles; dark reddish brown (5YR 3/2) moist; massive; slightly hard, firm, sticky and plastic; a few very fine roots; many, very fine, tubular pores; common, moderately thick clay films in pores; slightly acid (pH 6.5); gradual, smooth boundary.

C1m--17 to 20 inches, indurated cobbly hardpan; massive; diffuse, irregular boundary.

C2m--20 to 60 inches, strongly cemented and stratified cobblestones and pebbles of basic igneous origin.

Gravel and stone content ranges from 5 to 45 percent, by volume, throughout the profile. The B horizon is reddish brown or dark brown. Depth to cemented gravelly terrace alluvium may vary several inches, but because of inherent shallowness the range is only between 15 and 25 inches.

Included in mapping are small areas of Clear Lake clay, Clough gravelly loam, Diablo clay, and Goulding clay loam.

Permeability is slow in the subsoil over the very slowly permeable hardpan Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 2 to 4 inches. Fertility is low. Root and water penetration are restricted by the indurated hardpan.

This soil is used mainly for pasture or range. A few areas are used for vineyards where the soil is sufficiently deep. Capability unit IVe-3; range site 9.

Tuscan cobbly clay loam, 9 to 30 percent slopes (TuE).--This soil is similar to Tuscan cobbly clay loam, 0 to 9 percent slopes, but it is steeper and only 10 to 20 inches deep to underlying terrace hardpan.

Included in mapping are small areas of Clough gravelly loam, Diablo clay, and Goulding clay loam.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 1.5 to 3 inches.

This soil is used mainly for range and pasture. Capability unit VIe-3; range site 9.

Wright Series

The Wright series consists of somewhat poorly drained and moderately well drained loams that have a clay subsoil. They are underlain by old valley plain alluvium of mixed origin such as volcanic and marine sediment. These soils are mostly undulating, and are on low terraces. They are mainly on the central Santa Rosa Plain and south of the town of Sonoma. Slopes are 0 to 9 percent. Elevation ranges from 70 to 300 feet. Annual rainfall is 30 to 40 inches, annual temperature is between 52° and 54° F., and the frost-free season is 220 to 240 days. In most places the vegetation is chiefly annual and perennial grasses with scattered oak trees. The Wright soils are associated with the Clear Lake, Huichica, Yolo, and Zamora soils.

In a typical profile the surface layer is light brownish-gray, medium acid loam about 7 inches thick. The subsurface layer is light brownish-gray, medium acid loam and light brownish-gray and light gray, strongly acid sandy clay loam about 18 inches thick. The upper part of the subsoil is mixed light brownish-gray and light-gray, very strongly acid and strongly acid clay about 17 inches thick. The lower part of the subsoil is light brownish-gray, slightly acid clay and pale-brown, neutral clay about 20 inches thick. The substrata of light brownish-gray, slightly acid sandy clay loam occurs at a depth of about 62 inches.

Wright soils are used mainly for dryland and irrigated pasture. A few small areas of Wright soils with thicker surface layers are used for prune orchards.

Wright loam, wet, 0 to 2 percent slopes (WhA).--This nearly level soil has slightly concave slopes.

Typical profile in a pasture 1,000 feet west and 1,200 feet south of the junction of Sebastopol and Llano roads (NW corner of the NW1/4 SW1/4 sec. 31 T. 7 N., R. 8 W.); vegetation is annual grasses and scattered oaks. The profile was dry to a depth of 22 inches when examined:

A1--0 to 7 inches, light brownish-gray (10YR 6/2) loam that has common, medium, prominent, strong-brown mottles; very dark grayish brown (10YR 3/2) moist; massive; hard, friable, nonsticky and nonplastic; many fine and very fine roots; many, fine and medium, tubular pores; medium acid (pH 5.7); gradual, smooth boundary.

A21--7 to 15 inches, light brownish-gray (10YR 6/2) loam that has common, medium, prominent mottles; very dark grayish-brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many, fine and medium, tubular pores; medium acid (pH 6.0); gradual, smooth boundary.

A22--15 to 25 inches, light brownish-gray (10YR 6/2) and light gray (10YR 7/2) sandy clay loam that has a few, fine, faint yellowish-brown mottles; dark grayish brown (10YR 4/2) moist; massive; hard, friable, sticky and slightly plastic; many fine and very fine roots; many, fine and medium, tubular pores; strongly acid (pH 5.5); abrupt, smooth boundary.

B21t--25 to 32 inches, mixed light brownish-gray (10YR 6/2) and light-gray (10YR 7/2) clay that has common, medium, distinct, dark-gray (10YR 4/1) manganese stains; when moist, dark grayish brown (10YR 4/2) and having common, medium, distinct very dark-brown mottles; weak, coarse, prismatic structure; hard, very firm, sticky and very plastic; common very fine and fine roots; common, very fine and fine, tubular pores; continuous thick clay films on ped faces and in pores; very strongly acid (pH 5.0); gradual, smooth boundary.

B22t--32 to 42 inches, mixed light brownish-gray (10YR 6/2) and light-gray (10YR 7/2) clay that has common, medium, distinct, light-yellowish brown (10YR 6/4) mottles; when moist, dark brown (10YR 4/3) and having faint, dark yellowish-brown mottles; weak, coarse, prismatic structure; very hard, very firm, sticky and very plastic; common very fine and fine roots; common, very fine and fine, tubular pores; continuous thick clay films on ped faces and in pores; some fine manganese stains; strongly acid (pH 5.5); gradual, smooth boundary.

B23t--42 to 47 inches, light brownish-gray (10YR 6/2) clay, dark brown (10YR 4/3) moist; weak, coarse and very coarse, prismatic structure; very hard, firm, sticky and very plastic; a few very fine and fine roots; common, very fine and fine, tubular pores; continuous moderately thick clay films on ped faces and as

bridges; slightly acid (pH 6.5); gradual, smooth boundary.

B24t--47 to 62 inches, pale-brown (10YR 6/3) clay that has common, medium, distinct brown (10YR 5/3) mottles; when moist, dark grayish brown (10YR 4/2) and having faint dark-brown mottles; weak, coarse, prismatic structure; hard, firm, sticky and very plastic; a few very fine and fine roots; common fine tubular pores; continuous moderately thick clay films on ped faces and in pores; abundant fine manganese stains; neutral (pH 7.0); gradual, smooth boundary.

C--62 to 72 inches, light brownish-gray (10YR 6/2) sandy clay loam that has common, medium, distinct brown (10YR 5/3) mottles; when moist, olive brown (2.5Y 4/4) and having common, medium, distinct strong-brown mottles; weak, coarse, prismatic structure; hard, firm, sticky and very plastic; a few fine roots; common tubular pores; continuous moderately thick clay films on ped faces and in pores; slightly acid (pH 6.5); clear, wavy boundary.

The A horizon ranges from 20 to 30 inches in thickness and from very fine sandy loam to sandy clay loam in texture. The dry color of this horizon ranges from light brownish gray to light gray, or is a combination of both. The Bt horizon ranges from 20 to 70 inches in thickness and from grayish brown to pale brown or from light brownish gray to light gray in color. This layer is very strongly acid to neutral. It ranges from weak to strong coarse or very coarse prismatic structure. Manganese stained incipient hardpan occurs below the B horizon and is associated with the Wright soils. The C horizon ranges from fine sandy loam to clay in texture. It is slightly acid to mildly alkaline. Some gravel may occur in the lower part of the C horizon.

Included in mapping are small areas of Clear Lake clay, Huichica loam, Yolo loam, and Zamora silty clay loam.

Permeability is very slow in the subsoil of this Wright soil. Drainage is somewhat poor. Runoff is very slow, and the hazard of erosion is none to slight. Fertility is moderate. The available water capacity is 4 to 6 inches. Small amounts of water are available to plants from the clay subsoil. A water table, which develops above the clay subsoil as a result of heavy rains or irrigation, is maintained well into the growing season. This causes the soil to be difficult to work.

This soil is used mainly for pasture and hay. A few acres are used for prune orchards. Capability unit IIIw-3; wildlife group 3.

<u>Wright loam, 0 to 9 percent slopes</u> (WgC).--This soil is similar to Wright loam, wet, 0 to 2 percent slopes, but it does not maintain as much wetness after the rainy season. Also, the tendency for water to pond is not so great because of better surface drainage. Although most of this soil has slopes of 1 to 3 percent, slopes may be 6 to 9 percent on the edges of drainageways.

Included in mapping are small areas of Clear Lake clay, Huichica loam, and Zamora silty clay loam.

Drainage is moderately good. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Much of this soil is used for annual pasture. A few acres on the lower slopes are used for prune and walnut orchards. Capability unit IIIe-3.

<u>Wright loam, shallow, 0 to 5 percent slopes</u> (WmB).--This soil is similar to Wright loam, wet, 0 to 2 percent slopes, but the surface and subsurface layers are shallower. These layers range from 10 to 20 inches deep. This nearly level soil is in areas of slightly hummocky topography. It lacks the water table associated with the Wright loam, wet.

Included in mapping are small areas of Clear Lake clay, Huichica loam, and Zamora silty clay loam.

Drainage is moderately good. Runoff is slow, and the hazard of erosion is slight. The available water capacity is 3 to 5 inches.

This soil is used mainly for pasture. A few acres are used for prune orchards and vineyards. Capability unit IVe-3.

<u>Wright loam, shallow, wet, 0 to 2 percent slopes</u> (WoA).--This soil is similar to Wright loam, wet, 0 to 2 percent slopes, but the surface and subsurface layers range from only 10 to 20 inches in thickness.

Included in mapping are small areas of Clear Lake clay, Huichica loam, and Yolo loam.

Drainage is somewhat poor. The available water capacity is 3 to 5 inches.

This soil is used mainly for pasture. Capability unit IVw-3.

Yolo Series

The Yolo series consists of well-drained loams underlain by recent alluvium from sandstone and shale. These soils are on alluvial fans and flood plains. They are mainly in the valley areas of the county along the Russian River and Dry Creek channels and along other major drainageways. Slopes are 0 to 5 percent. Elevation ranges from 70 to 500 feet. Annual rainfall is 30 to 70 inches, annual temperature is 60° to 62° F., and the frost-free season is 240 to 260 days. Where not cultivated the vegetation is chiefly annual and perennial grasses, forbs, shrubs, wild berry vines, and scattered oak trees. The Yolo soils are associated with the Cortina, Pajaro, Pleasanton, and Zamora soils.

In a typical profile the surface layer is grayish-brown, neutral loam about 8 inches thick. The next layer is grayish-brown, neutral loam extending to a depth of more than 60 inches.

Yolo soils are used mainly for orchards, vineyards, row crops, and truck crops. Many irrigated areas are used for hay crops and pasture.

Yolo loam, 0 to 2 percent slopes (YnA).--This nearly level soil is on alluvial fans. The slight slopes are very long and smooth.

Typical profile in a prune orchard; slope of 1 percent; 5.5 miles south of Healdsburg on West Side Road (NW1/4 SW1/4 sec. 21, T. 8 N., R. 9 W.); the profile was moist when examined:

A1--0 to 8 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive and moderate, fine, crumb structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common, very fine and fine, interstitial and tubular pores; worm casts common; neutral (pH 7.0); diffuse, wavy boundary.

C--8 to 60 inches, grayish-brown (10YR 5/2) loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common, very fine and fine, interstitial and tubular pores; common worm casts to a depth of 40 inches; neutral (pH 7.0).

The A horizon ranges in color from light brownish gray to dark grayish brown. The C horizon is usually brown, light yellowish brown, or grayish brown. The profile varies from slightly acid to moderately alkaline, but is generally neutral throughout. The profile is dominantly loam, but it has a thin, moderately fine or moderately coarse strata.

Included in mapping are small areas of Cortina very gravelly sandy loam, Pajaro gravelly loam, Pleasanton loam, and Zamora silty clay loam.

Permeability is moderate in this Yolo soil. Runoff is slow, and the hazard of erosion is slight. Fertility is high. The available water capacity is 9 to 11 inches.

This soil is used mainly for prune orchards and vineyards. It also is used for other types of orchards, row crops, and pasture. Capability unit I-1.

Yolo loam, overwash, 0 to 5 percent slopes (YoB).--This soil is similar to Yolo loam, 0 to 2 percent slopes, but because of its location where inundation and overflow are minor hazards, this soil stays wet for longer periods of time.

Included in mapping are small areas of Cortina very gravelly loam, Pleasanton loam, and Zamora silty clay loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for orchards, vineyards, row crops, and pastures. Capability unit IIw-2.

Yolo sandy loam, 0 to 2 percent slopes (YlA).--This soil is similar to Yolo loam, 0 to 2 percent slopes, but the texture of the surface layer is sandy loam, 12 to 18 inches deep and the color is generally light brownish gray. This soil also has a tendency to be more stratified.

Included in mapping are small areas of Cortina very gravelly sandy loam, Pajaro gravelly loam, and Zamora silty clay loam.

The available water capacity is 8 to 10 inches.

This soil is used mainly for prune orchards and for vineyards. Other types of orchards, row crops, and pastures are also grown. Capability unit I-1.

Yolo sandy loam, overwash, 0 to 5 percent slopes (YmB).--This soil differs from Yolo loam, 0 to 2 percent slopes, in that its surface layer is sandy loam. This Yolo loam is subject to flooding and consequent deposition because of its topographic position along rivers and creeks.

Included in mapping are small areas of Cortina very gravelly sandy loam, Pleasanton loam, and Zamora silty clay loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 8 to 10 inches.

This soil is used mainly for orchards and vineyards. Some areas are used for pasture. Capability unit IIw-2.

Yolo gravelly loam, 0 to 5 percent slopes (YrB).--This soil differs from Yolo loam, 0 to 2 percent slopes. It contains 15 to 30 percent gravel in the surface layer. Slope ranges from nearly level to gently sloping and undulating. This Yolo soil tends to be more stratified with coarse materials. Because it generally occurs close to prominent waterways, it is occasionally inundated for very short periods.

Included in mapping are small areas of Cortina very gravelly sandy loam, Pajaro gravelly loam, and Zamora silty clay loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for prune orchards, vineyards, row crops, and pastures. Capability unit IIe-1.

Yolo silt loam, 0 to 2 percent slopes (YsA).--Generally, this soil is more stratified than Yolo loam, 0 to 2 percent slopes. The silt loam surface layer is a result of deposition from infrequent overflow and the sloughing of finer-textured soil material from areas bordering this soil.

Included in mapping are small areas of Cortina very gravelly sandy loam, Pajaro gravelly loam, Pleasanton loam, and Zamora silty clay loam.

The available water capacity is 10 to 12 inches.

This soil is used mainly for orchards, vineyards, row crops, and pasture. Capability unit I-1.

Yolo clay loam, 0 to 2 percent slopes (YtA).-This soil is similar to Yolo loam, 0 to 2 percent slopes, but the surface layer is dark grayish-brown and very dark grayish-brown clay loam.

Included in mapping are small areas of Pajaro gravelly loam, Pleasanton loam, and Zamora silty clay loam.

The available water capacity is 10 to 12 inches.

This soil is used mainly for orchards. Vineyards, row crops, and pasture also grow on this soil. Capability unit I-1.

Yorkville Series

The Yorkville series consists of moderately well drained clay loams that have a clay subsoil. They formed in material weathered from glaucophane-schist, serpentinized igneous rocks, and metamorphosed graywacke that are at a depth of 24 to 60 inches. These soils are on ridgetops, side slopes, and mountainous uplands, mainly in the north-central part of the county. The soils on mountainous uplands are very steep. Slopes are 5 to 75 percent. Elevation ranges from 300 to 2,500 feet. Annual rainfall is 30 to 70 inches, annual temperature is 54° to 56° F., and the frost-free season is 230 to 250 days. In most places the vegetation is chiefly annual and perennial grasses, forbs, and a few scattered oak and madrone trees. The Yorkville soils are associated with the Hugo, Josephine, Laughlin, and Suther soils.

In a typical profile the surface layer is dark grayish-brown, slightly acid and medium acid clay loam about 14 inches thick. The subsoil, to a depth of 60 inches, is grayish-brown, dark grayish-brown, and dark-gray, slightly acid to moderately alkaline heavy clay loam and clay.

Yorkville soils are used mainly for range and for grazing by sheep and cattle. A few areas that are on lesser slopes are used for dryland hay crops and pasture.

Yorkville clay loam, 5 to 30 percent slopes (YuE).--This moderately steep soil is on uplands. Generally, slopes range from 15 to 30 percent, and they are long and smooth.

Typical profile under a cover of grass; slope faces west; at an elevation of 1,450 feet; 2.5 mile south-southwest of Hedgepeth Lake (NE1/4 NW1/4 sec. 28, T. 9 N., R. 12 W.):

A11--0 to 8 inches, dark grayish-brown (2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, coarse, subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine roots; many, very fine and fine, tubular and interstitial pores; slightly acid (pH 6.5); diffuse boundary.

A12--8 to 14 inches, dark grayish-brown (2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, coarse, subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many, very fine and fine, tubular and interstitial pores; medium acid (pH 6.0); diffuse boundary.

B21t--14 to 19 inches, grayish-brown (2.5Y 5/2) heavy clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; common very fine and fine roots; many, very fine and fine, tubular pores; many moderately thick clay films as bridges, in pores, and on ped faces; slightly acid (pH 6.5); clear, wavy boundary; appears to be stone line between A12 and B21t.

IIB22t--19 to 32 inches, dark grayish brown (2.5Y 4/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, medium, subangular blocky structure; extremely hard, firm, sticky and very plastic; a few very fine roots; many, very fine, tubular pores; mildly alkaline (pH 7.5); clear, wavy boundary.

IIIB23t--32 to 60 inches, dark-gray (5Y 4/1) clay, dark-gray (5Y 4/1) moist; strong, coarse and very coarse, angular blocky structure; extremely hard, firm, very sticky and very plastic; a few very fine roots; common, very fine, tubular pores; many moderately thick clay films as bridges, on ped faces, and in pores; moderately alkaline (pH 8.0); grades into fault gouge consisting of dense gray clay matrix and lenticular and subangular fragments of graywacke and schist (glaucophane, actinolite, and chlorite), often with calcite seams.

The A horizon varies from reddish brown to grayish brown or dark grayish brown in color. This horizon is neutral to medium acid. The colors of the B horizon are olive, olive brown, grayish brown, dark gray or dark grayish brown. This horizon is medium acid to moderately alkaline. The subsoil may contain slickensides and variable amounts of rock fragments. Soil depth to rock ranges from 24 to 60 inches within short distances. Rock replaces the clay parent material.

Included in mapping are small areas of Hugo loam, Josephine loam, Laughlin loam, and Suther loam.

Permeability is very slow in the subsoil of this Yorkville soil. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Fertility is moderately high. The available water capacity is 4 to 6 inches. This soil is subject to landslips.

This soil is used mainly for range. Capability unit VIe-3; range site 2.

Yorkville clay loam, 30 to 50 percent slopes (YuF).--This soil is steeper than Yorkville clay loam, 5 to 30 percent slopes. Depth to bedrock ranges from 24 to 60 inches, but generally it occurs between 36 and 50 inches. Landslips and gullies are present.

Included in mapping are small areas of Josephine loam, Laughlin loam, and Suther loam.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly for range. Other areas are used for wildlife cover and for watershed. Capability unit VIe-3; range site 6.

Yorkville-Laughlin complex, 30 to 50 percent slopes (YvF).--This complex is scattered across the northern half of the county. Yorkville soils make up about 60 percent of the complex, and Laughlin soils about 40 percent. The proportions, however, vary from area to area. Included in mapping are a few stony and eroded areas that have stones, rock outcrops, and landslips. Landslips are more common on the Yorkville soils. In some areas, the Laughlin soils have outcrops of sandstone knobs. The Yorkville soils generally have convex slopes with seepage on the lower toe slopes.

The Yorkville soils have a profile similar to that of Yorkville clay loam, 5 to 30 percent slopes. Runoff is rapid, and the hazard of erosion is high.

The Laughlin soils have a profile similar to that of Laughlin loam, 50 to 75 percent slopes. Runoff is rapid, and the hazard of erosion is high.

These soils are used mainly for range and pasture. Capability unit VIe-3; Yorkville, range site 6; Laughlin, range site 4.

Yorkville-Suther complex, 0 to 50 percent slopes (YwF).--This complex is in the northeast ranges of the county north of Healdsburg. Yorkville soils are dominant in areas that have a cover of grass; Suther soils are dominant in areas that have a cover of scattered oak. This complex is composed of about 65 percent Yorkville clay loam, 25 percent Suther loam, approximately 9 percent Laughlin soils, and about 1 percent Montara soils. Rock outcrops commonly are on Yorkville soils, and both soils are subject to landslips.

The Yorkville soils have a profile similar to that of Yorkville clay loam, 5 to 30 percent slopes. Runoff is slow to rapid, and the hazard of erosion is slight to high.

The Suther soils have a profile similar to that of Suther loam, 15 to 30 percent slopes. Runoff is slow to rapid, and the hazard of erosion is slight to high.

These soils are used mainly for range and pasture. Capability unit VIe-3; range site 6.

Yorkville-Suther complex, 50 to 75 percent slopes (YwG).--This mapping unit is similar to Yorkville-Suther complex, 0 to 50 percent slopes, but it is steeper. It is east and north of Nights Valley and east of the Russian River. Yorkville clay loam makes up about 50 percent of the complex, and Suther loam about 50 percent. The Suther soils most commonly occur on the upper slopes. Gullying on Suther soils and landslips on Yorkville and Suther soils are frequent.

The Yorkville soils have a profile similar to that of Yorkville clay loam, 5 to 30 percent slopes. Runoff is very rapid, and the hazard of erosion is very high.

The Suther soils have a profile similar to that of Suther loam, 15 to 30 percent slopes. Runoff is very rapid, and the hazard of erosion is very high.

These soils are used mainly for range and pasture. Capability unit VIIe-3; range site 6.

Zamora Series

The Zamora series consists of well-drained clay loams that have a mainly clay loam subsoil formed in recent alluvium from mixed sedimentary sources. These soils are on alluvial fans. They are mainly in the large valleys and drainageways of the county along the channels of the Russian River, and the Dry, the Sonoma, and the Santa Rosa Creeks. Slopes are 0 to 5 percent. Elevation ranges from 70 to 500 feet. Annual rainfall is 30 to 45 inches, annual temperature is 60° to 62° F., and the frost-free season is 240 to 260 days. Where not cultivated, vegetation is chiefly annual and perennial grasses, forbs, and scattered oak trees. The Zamora soils are associated with the Cole, Cortina, Pajaro, and Yolo soils.

In a typical profile the surface layer is grayish-brown, slightly acid silty clay loam and dark grayish-brown, neutral clay loam about 29 inches thick. The subsoil, to a depth of more than 60 inches, is dark grayish-brown neutral clay loam and dark-brown sandy clay loam and gravelly clay.

Zamora soils are used mainly for vineyards, orchards, and row and truck crops. Many irrigated areas are used for pasture and hay crops.

Zamora silty clay loam, 0 to 2 percent slopes (ZaA).--This nearly level soil is on alluvial fans and flood plains.

Typical profile 450 feet north and 100 feet east of railroad crossing on Britton Lane (NE1/4 NW1/4 sec. 28, T. 7 N., R. 8 W.):

A11--0 to 5 inches, grayish-brown (10YR 5/2) silty clay loam, very dark gray (10YR 3/1) moist; massive; very hard, firm, very sticky and very plastic; many very fine and fine roots; many, very fine and fine, tubular pores; slightly acid (pH 6.2); clear, smooth boundary.

A12--5 to 17 inches, dark grayish-brown (10YR 4/2) clay loam, very dark gray (10YR 3/1) moist; strong, medium and coarse, angular blocky structure; extremely hard, firm, very sticky and very plastic; many very fine, medium, and coarse roots; many, very fine, interstitial pores; many thick organic coatings on ped faces; neutral (pH 7.0); clear, wavy boundary.

A13--17 to 29 inches, dark grayish-brown (10YR 4/2) clay loam that has common, fine, faint, dark yellowish-brown (10YR 4/4) mottles; when moist, very dark gray (10YR 3/1) and having common, fine, faint, brownish-yellow mottles; strong, medium and coarse, angular blocky structure; hard, friable, very sticky and very plastic; common very fine roots and a few medium roots; many, very fine, interstitial pores; many thick organic coatings on ped faces; neutral (pH 7.0); diffuse wavy boundary.

B21t--29 to 41 inches, dark grayish-brown (10YR 4/2) clay loam, dark gray (10YR 4/1) moist; strong, medium and coarse, angular blocky structure; hard, friable, very sticky and very plastic; a few very fine roots; many, very fine, tubular pores; many moderately thick clay films in pores and as bridges; neutral (pH 7.0); clear, wavy boundary.

B22t--41 to 55 inches, dark-brown (10YR 4/3) sandy clay loam, very dark grayish brown (10YR 3/2) moist; strong, coarse and medium, angular blocky structure; slightly hard, friable, very sticky and very plastic; many very fine roots; many, very fine, tubular pores; many thick and moderately thick clay films in pores; as bridges, and on ped faces; neutral (pH 7.0); diffuse, wavy boundary.

Shifting sand dunes on ocean coast stabilized by planting of European beachgrass; Kneeland and Bodega soils are on hills in background.

Logging Douglas-fir on Empire loam, 9 to 30 percent slopes.

Hugo very gravelly loam, 50 to 75 percent slopes, eroded. Removal of trees to convert to grazing accelerated erosion.

Huichica loam, ponded, in rainy season.

Strong competition from invading brackenfern makes forage nearly worthless on Mendocino sandy clay loam, 9 to 30 percent slopes.

Beef cattle on Suther loam.

PLATE IV

Subdivision encroaching on Zamora and Yolo soils.

Alluvial land flooded by runoff from Santa Rosa Creek in winter.

Landslip on overgrazed area of Kinman loam, 30 to 50 percent slopes.

Shallow-rooted conifers felled by windthrow on Caspar sandy loam.

B23t--55 to 60 inches, dark-brown (10YR 3/3) gravelly clay, dark brown (10YR 4/3) moist; strong, coarse and medium, angular blocky structure; slightly hard, firm, very sticky and very plastic; many very fine roots; many, very fine, tubular pores; many thick and thin clay films in pores and on ped faces; neutral (pH 7.0).

The A horizon ranges from dark grayish brown to grayish brown or dark brown in color, and from silty clay loam to loam in texture. The B horizon ranges from dark grayish brown or dark brown to dark yellowish brown in color, and from clay loam to silty clay loam in texture. The lower B horizon may be clay or gravelly clay. The horizon ranges from neutral to slightly acid throughout.

Included in mapping are small areas of Cole clay loam, Cortina very gravelly loam, Pajaro clay loam, and Yolo clay loam.

Permeability is moderately slow in the subsoil of this Zamora soil. Runoff is slow, and the hazard of erosion is slight. The available water capacity is 11 to 13 inches. Fertility is high.

This soil is used mainly for orchards, vineyards, and pasture. Row crops are also grown. Capability unit I-1.

Zamora silty clay loam, 2 to 5 percent slopes (ZaB).--This soil is similar to Zamora silty clay loam, 0 to 2 percent slopes, but it is slightly steeper. This soil also is in the central Santa Rosa plains and in the Sonoma Valley.

Included in mapping are small areas of Cortina very gravelly loam, Pajaro clay loam, and Yolo clay loam.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used mainly for orchards, vineyards, and pasture. Capability unit IIe-1.

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In this section general management practices are discussed, and the capability classification commonly used by the Soil Conservation Service is described. Then the capability units are explained and suggestions for managing the soils in each capability unit are given. Following this, estimated yields of the principal crops are given for those soils in the county that are widely used for crops, and the management used to obtain these yields are described and the Storie index is explained. After that management of range sites and woodland and wildlife groups is described and engineering uses of the soils are discussed.

General Management Practices

In the paragraphs that follow, the chief management practices for all the soils of Sonoma County suitable for tilled crops and pasture are briefly discussed. The chief concerns in farming the soils are keeping tillage to a minimum, growing cover crops, seeding suitable mixtures, maintaining fertility, irrigating, choosing a suitable cropping system, providing drainage, protecting streambanks, and controlling brush. Technical assistance in planning and applying practices suitable for the soils on a particular farm can be obtained from local representatives of the Soil Conservation Service and the Extension Service.

Minimum tillage.--Keeping tillage to a minimum is effective in reducing erosion and the breakdown of soil structure. An animal traffic pan or plowpan tends to form below the plow layer in many soils in the county. Such a pan consists of a firm, dense layer 2 to 4 inches thick, that occurs at a depth of 3 to 10 inches. The pan limits permeability and, in places, restricts the penetration of roots. Varying the depth of plowing, or disking, and infrequent shallow subsoiling help to break up the pan.

Cover crops.--A volunteer growth of plants such as ryegrass, mustard, and wild radish provide green manure. These plants are plowed into the soil when the seedbed is prepared in spring or in fall. Horsebeans, vetch, other legumes, and grasses are planted in many orchards and are plowed under at the proper time. They help to improve the workability of the soil and to improve the intake of water.

Seeding.--Mixtures of commercial seeds are planted on many thousands of acres to improve the yield of forage. Hardinggrass, fescue, brome, perennial rye, subterranean clover, ladino clover, and birdsfoot trefoil are among the grasses and legumes grown in the county. Different seed mixtures are used for dryland and irrigated pasture. A ground cover of grasses and legumes helps to stabilize the soils, and if the plants are irrigated and fertilized, to increase the yield of forage.

Maintaining fertility.--Soils that are intensively cultivated need applications of barnyard manure and commercial fertilizer to produce good forage and to aid the growth of field crops, trees, and row crops. Chicken manure is used extensively on pasture and row crops. Most of the commercial fertilizer used in the county is a mixture of nitrogen and phosphorus. In a few areas, particularly where row crops are grown, potassium is used, though the soils in most cultivated areas have sufficient potassium.

Irrigation.--Where water is available irrigation is practiced. The water is applied by sprinklers. As more water sources are developed, more acreage is irrigated. Irrigation water applied two or three times in summer improves the yields of orchards and vineyards. For best results water is applied at proper growth times. Streams, ground water, and reservoirs are sources of water.

Cropping systems.--A conservation cropping system is the growing of crops in combination with needed cultural and management measures. An example of a typical cropping system in Sonoma County is field corn planted for one or two times, and then alternated with an oat hay or vetch crop. In choosing a cropping system, the kind of soils on the farm, the farm organization, and the market are considered.

Drainage.--Tile drains are used in places to improve drainage on soils in the areas that are somewhat poorly drained and poorly drained or that are ponded during the rainy season. The drainage helps to relieve waterlogging of the subsoil and to improve cultivation in seep areas. Land smoothing and leveling helps to control surface runoff and to improve the efficiency of applying irrigation water.

Protecting streambanks.--Protection is needed along streambanks and drainageways that are subject to scouring by runoff during heavy rains. Placing piles tied together with heavy cable and planks along the Russian River and large creeks helps to protect their banks. Building drop inlets slows the velocity of runoff in tributaries and small field drains. Plants grown along swales and on graded banks help to control erosion and to prevent further sloughing.

Controlling brush.--A major concern to management is the control of encroaching brush and unwanted plants. Coyote brush, manzanita, poison oak, and broom are common kinds of brush. The spread of thistle and medusahead has reduced the quality and quantity of forage. Spraying, burning, or chopping helps to eradicate some of these invaders. After the brush and other undesirable plants are eliminated, volunteer stands of ryegrass, burclover, bromegrass, fescue, and the seeding of commercial seeds produce forage of better quality.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of common crops. The groups are made according to the limitations of the soils when used for common crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that

would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, forest trees, or engineering.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. (None in Sonoma County.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, e, w, s, or c, to the class numeral, for example, IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, saline, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by w, s, and c, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convient grouping for making many statements about management of soils.

Capability units in California are given Arabic numbers that suggest the chief kind of limitation responsible for placement of the soils in the capability class and subclass. For this reason, some of the units within the subclasses are not numbered consecutively, and their symbols are a partial key to some of the soil features. The numerals used to designate units within the classes and subclasses are these:

0. A problem or limitation caused by sand and gravel in the substratum.
1. An actual or potential erosion hazard.
2. A problem or limitation of wetness caused by poor drainage or flooding.
3. A problem or limitation caused by slow or very slow permeability of the subsoil or substratum.
4. A problem or limitation caused by coarse soil texture or excessive gravel.
5. A problem or limitation caused by fine or very fine textured surface soil.
6. A problem or limitation caused by salt or alkali. (Not applicable in Sonoma County.)
7. A problem or limitation caused by cobblestones, other stones, or rock outcrops.
8. A problem or limitation caused by shallowness to bedrock or hardpan.
9. A problem or limitation caused by low fertility or by toxicity.

Management By Capability Units

In the pages that follow, the capability units in Sonoma County are described and suggestions for use and management of the soils are given. Soil series names are mentioned in each capability unit, but this does not mean that all mapping units of the series are in that particular unit. The soils in each unit are listed in the "Guide to Mapping Units" at the back of the survey.

Capability Unit I-1

This unit consists of well-drained soils in the Pleasanton, Yolo, and Zamora series. These soils

have a surface layer of sandy loam to silty clay loam. Most areas are on alluvial fans and terraces. Slopes are less than 2 percent. Depth of these soils is 60 inches or more. In places the soils are stratified, but the texture in the layers is neither fine enough nor coarse enough that root penetration and moisture storage are impaired.

The total available water capacity in these soils is 8 to 13 inches. Reaction is medium acid to neutral, except in areas where reaction has been changed by management practices. Fertility is high. Permeability is moderate to moderately slow.

These soils are suited to all crops grown in the county, including row, field, truck, and special crops and tree crops. They also are suited to hay and pasture.

Soils in this unit respond well to good management. Erosion is not a hazard in areas that are well managed. Flooding occurs occasionally in small areas but requires no special management.

Capability Unit IIe-1

This unit consists of soils in the Arbuckle, Los Robles, Manzanita, Pleasanton, Yolo, and Zamora series. Many of these soils are on alluvial fans; others are in small valleys, on low benches, and on terraces. Many of the soils are on recent alluvial fans and have little stratification. The soils on terraces have slight accumulations of clay in the subsoil. Nearly all soils of this unit are more than 60 inches deep. The surface layer is sandy loam to silty clay loam, and many of the soils are gravelly. These soils are well drained. They are similar to soils in capability unit I-1, except that slopes range from 0 to 9 percent. A few of the soils are underlain by gravel or other material at a depth of about 36 to 48 inches. Small areas of these soils that have slopes up to 2 percent are subject to deposition.

The total available water capacity in these soils is 5 to 13 inches. Reaction generally is medium acid to neutral, but in places it is very strongly acid in poorly managed cultivated areas. Permeability is moderate to moderately slow. Roots and water readily penetrate the subsoil and substratum.

These soils are suited to all crops grown in the county, including row, truck, field, and special crops and tree fruit and nut crops.

The soils in this unit are relatively fertile and are fairly easy to till. They respond to good management, including the use of fertilizers. The hazard of erosion is moderate in cultivated areas. It can be reduced by doing all tillage across the slope. Returning all crop residue to the soils helps to improve tilth and fertility.

Capability Unit IIe-5

This unit consists of clay soils of the Clear Lake, Diablo and Raynor series. These soils are on foot slopes or terraces and on the edges of basins. Slopes are 2 to 9 percent. Wide cracks form in the surface of these soils when they dry. Some of these soils are more than 60 inches deep, and others are 40 to more than 60 inches deep to sandstone or siltstone.

The total available water capacity in these soils ranges from 6 to 10 inches. These soils absorb moisture rapidly until the cracks in the surface close, and then the intake becomes slow or very slow. Reaction is medium acid to moderately alkaline. Fertility is moderately high. Permeability is slow. These soils are naturally well drained or poorly drained, but drainage has been provided.

These soils are slow to warm in spring. They are better suited to hay, forage, and field crops than to other crops.

Preparing a seedbed in these soils is difficult because large clods form unless the soils are worked at the right moisture content. Cultivating across the slope helps to reduce the hazard of erosion. Returning all crop residue to the soils helps to improve soil structure and increase the rate of infiltration. Crops on these soils respond if fertilizer that contains nitrogen is applied.

Capability Unit IIw-2

This unit consists of poorly drained or moderately well drained soils of the Blucher, Cole, Pajaro, and Yolo series. These soils have a surface layer of fine sandy loam to clay loam. They are subject to frequent flooding in some areas and infrequent flooding in others. Slopes range from 0 to 5 percent. In places many of these soils are stratified or have a fine-textured layer at a depth of 40 to more than 60 inches. Some of the soils are subject to deposition.

The total available water capacity in drained areas is 6 to 11 inches. Reaction is medium acid to moderately alkaline. Fertility is moderately high to high.

If drainage is provided and suitable varieties of crops are planted, these soils are well suited to most field, forage, row, and truck crops. Most of the soils are poorly suited to commercial tree crops unless artificial drainage is provided and carefully selected species are planted.

These soils are fairly easy to till, and they respond to good management. The hazard of erosion can be reduced on the sloping soils by cultivating across the slope. In places the water table is at a depth of 3 to 5 feet during part of some years. Tile drains or open ditches are needed to lower the water table in these areas and to keep it lowered. Generally a suitable drainage outlet is difficult to obtain in the Pajaro soils.

Capability Unit IIs-4

Los Robles gravelly clay loam, 0 to 2 percent slopes, is the only soil in this unit. This well-drained soil is on alluvial fans. Depth to the gravelly substratum ranges from 40 to more than 60 inches.

The total available water capacity in this soil is about 7 to 8.5 inches. Permeability is moderately slow. Reaction is slightly acid to medium acid. The hazard of water erosion is slight. Fertility is high.

This soil is moderately well suited to field, forage, row, and truck crops, to stone fruits, and to nuts. Special selection of varieties and types of crops are required for good results.

This soil responds well to good management, including the use of fertilizer. It has lower water-holding capacity than soils in class I and therefore requires more frequent irrigation.

Capability Unit IIs-5

In this unit are soils of the Clear Lake series and the land type Alluvial land, clayey. Some of these soils are moderately well drained and others are drained and on the edge of basins. Slopes generally are less than 2 percent, but along the edge of the larger basins they are less than 1 percent. The surface layer is clay loam to silty clay, and wide cracks form as it dries. The Clear Lake soils are more than 60 inches deep. They have thick layers of fine gravel at a depth below 20 to 40 inches in places.

The total available water capacity varies in Alluvial land, clayey, and is 8 to 10 inches in Clear Lake soils. Infiltration is rapid, and moisture is absorbed rapidly until the cracks in the surface close; after that infiltration is slow or very slow. Fertility varies.

The soils and land type in this unit are better suited to field and forage crops and to certain row crops than to other crops. They are also suited to prunes, pears, and grapes.

Alluvial land, clayey, and Clear Lake soils are slow to warm in spring. Crops on them generally respond to nitrogen fertilizer. Preparing a seedbed is difficult because hard clods form unless the soils are worked at the right moisture content. Returning all crop residue to the soil helps to improve tilth and structure.

Capability Unit IIIe-1

In this unit are well drained and moderately well drained soils of the Arbuckle, Goldridge, Goulding, Kneeland, Laniger, Red Hill, Rohnerville, Sebastopol, and Steinbeck series. These soils have a surface layer of gravelly sandy loam to clay loam. They are on low hills and benches. Slopes range from 0 to 15 percent. Depth to rock or weakly cemented material ranges from about 30 to more than 60 inches. In soils that formed in alluvium, depth is more than 60 inches. In soils that are less than 60 inches deep, partly consolidated terrace gravel, soft sandstone, and shale are at a depth of 30 to more than 60 inches. Drainage is not restricted in the soils that are less than 60 inches deep to bedrock.

The total available water capacity in these soils is about 4 to 11 inches. Reaction is very strongly acid to neutral. Fertility is moderately high to moderately low. Permeability is moderate to moderately slow, but roots and moisture penetrate the soil material readily.

These soils are suited to most crops grown in the county, including forage, field, and row crops. Stone fruits and nuts can also be grown, but some varieties are not well suited on soils that are less than 5 feet deep. The soils also are suited to pasture and timber.

All tillage and irrigation must be done across the slope or on the contour to reduce the erosion hazard. Leaving stubble on the surface or keeping a cover of plants on the soils during the rainy season helps to slow runoff and thus to reduce erosion. Additional information about management of these soils can be found in the sections "Use of the Soils for Range" and "Use of the Soils for Woodland."

Capability Unit IIIe-3

In this unit are moderately well drained to well drained soils of the Clough, Cotati, Dibble, Haire, Huichica, Los Osos, Pleasanton, Positas, Spreckels, and Wright series. These soils are on old terraces, fans, and uplands. Slopes are 0 to 15 percent. The surface layer is sandy loam to clay loam that is gravelly in places. Some of these soils are more than 60 inches deep. In others depth to the clay subsoil is 18 to 60 inches. These soils are subject to erosion.

The total available water capacity is 3.5 to 10 inches. Reaction generally ranges from extremely acid to neutral. Fertility is low to moderately high. Permeability of the subsoil is very slow or slow.

These soils are well suited to field and forage crops. Some areas are suited to such special crops as strawberry plants or cut flowers. Deeper soils that are slowly permeable are suited to certain timber crops.

Cultivating across the slope helps to reduce the hazard of erosion. Keeping a cover of plants on the soils during the rainy season helps to control erosion. Fertility and tilth can be maintained by turning under all crop residue and adding other kinds of organic matter. Sprinklers are better suited than other methods for applying irrigation water, though furrows can be used if they are laid across the slope. Crops on these soils generally respond if fertilizer that contains nitrogen and phosphorus is applied.

Capability Unit IIIe-4

Baywood loamy sand, 2 to 9 percent slopes, is the only soil in this unit. It is a somewhat excessively drained, droughty soil that formed in wind-blown deposits. Texture throughout the profile is loamy sand to sand.

The total available water capacity is about 4 to 6 inches. Reaction is medium acid. Natural fertility is low.

This soil warms early in spring and is suitable for early row crops. It is also suited to forage

crops and to such special crops as strawberry plants. In nearly all areas irrigation is needed for good growth of row crops, vineyards, orchards, and hay crops during the warm, dry season. Streambank erosion is a hazard in places, and soil blowing occurs in exposed areas. Keeping a cover of plants on the soil helps to reduce the hazard of soil blowing during periods of high wind. Crops on this soil respond well to nitrogen fertilizer. Frequent irrigation is necessary, but the water should be applied in small amounts to avoid waste of water and to prevent leaching.

Capability Unit IIIe-5

This unit consists of well-drained clays in the Diablo and Raynor series. These soils are on low hills and sloping benches. Slopes are 9 to 15 percent. Depth to sandstone, siltstone, or compacted very cobbly or stony clay ranges from about 20 inches to more than 60 inches.

The total available water capacity in these soils is about 4 to 9 inches. Roots and moisture penetrate the soil material readily. Reaction is slightly acid to moderately alkaline. The hazard of erosion is moderate in cultivated areas. Fertility is moderately high to high. Permeability is slow.

Most crops grown in the county can be grown on these soils, including field, forage, and row crops. These soils are also suited to some special truck crops. The choice of crops is limited by the fine texture and somewhat limited depth of the soils.

Cultivating across the slope or on the contour helps to reduce the hazard of erosion on these soils. These soils can be tilled, however, only within a narrow range of moisture content. Sprinklers that have a low-volume output are best to use for applying irrigation water. Turning under cover crops, returning all crop residue to the soils, and adding other kinds of organic matter are ways to help improve soil structure and to increase the rate of infiltration.

Capability Unit IIIw-2

This unit consists of somewhat poorly drained soils in the Pajaro series. These soils occur along stream channels or are adjacent to steeper areas where runoff is high. Slopes are 0 to 5 percent. The surface layer is clay loam. These soils are subject to frequent flooding and deposition from nearby streams.

The available water capacity, based on a 60-inch root zone, is 8 to 10 inches. Reaction ranges from slightly acid to mildly alkaline. Fertility is moderately high. Permeability is moderate.

These soils are suited to hay, pasture, truck crops, and orchards.

Channels, dikes, or levees are needed to protect these soils from flooding. On the gently sloping soils, all tillage should be done across the slope to reduce the hazard of erosion. Crops on these soils respond if fertilizer that contains nitrogen and phosphorus is applied. If these soils are adequately protected from flooding, they can be used and managed about the same as soils in capability units I-1 and IIe-1.

Capability Unit IIIw-3

This unit consists of somewhat poorly drained soils in the Huichica and Wright series. Slopes are 0 to 5 percent. The nearly level soils are on old terraces and flood plains, and the gently sloping ones are on fans. The general lay of the land is nearly level, and the surface is uneven. These soils have a surface layer of loam that varies considerably in thickness, but generally is 18 to 30 inches thick. The subsoil is clay that is very slowly permeable and restricts penetration of water and roots. These soils are subject to ponding or flooding in wet weather.

The total available water capacity ranges from about 3.5 to 6 inches. Reaction generally is strongly acid to moderately alkaline. Fertility is moderate.

These soils are well suited to shallow-rooted crops, such as pasture and annual hay. They are suited to most field, forage, and row crops if suitable varieties are planted and if water is controlled. In places grapes grow well, but tree crops are not suited. Perennial grasses are well suited because of the slowly available moisture from the subsoil.

Drainage is difficult to provide on these soils because of the very slowly permeable subsoil and because suitable outlets are lacking. Surface drainage can be improved, however, if rough leveling or smoothing is done with care. Irrigation water must be carefully applied to prevent further buildup of excess water in these soils.

Capability Unit IIIw-5

Clear Lake clay, ponded, 0 to 2 percent slopes, is the only soil in this unit. It is poorly drained and is at a low elevation, generally in flat basins or in long, narrow valleys. This ponded, soil is subject to deposition.

The available water capacity in drained areas is 8 to 10 inches. Reaction is medium acid to moderately alkaline. Fertility is moderately high. Permeability is slow. Erosion is not a hazard.

This soil is well suited to certain varieties of field, forage, row, and truck crops. Flooding late in spring delays planting in low areas in valleys.

This soil is difficult to manage because of its clay texture. The water table commonly is at a depth of 3 to 5 feet, and open ditches or tile drains are required to lower the water table and to keep it below the root zone. In places root penetration is impeded by the combined effects of the high water table and slow permeability. Artificial drainage has been provided in some areas. Returning crop residue and other organic matter to the soils

helps to improve tilth and structure and to increase the rate of infiltration.

Capability Unit IIIs-3

Huichica loam, 0 to 2 percent slopes, is the only soil in this unit. This moderately well drained soil is on valley plains and low terraces. The subsoil is clay, and it is underlain by a hardpan. The soil ranges from 25 to 40 inches in depth.

The total available water capacity in this soil is about 3.5 to 5 inches. Reaction is strongly acid to moderately alkaline. Fertility is moderate. The subsoil is slowly permeable, and the underlying hardpan is nearly impermeable.

This soil is suited to vineyards, irrigated and dry pasture, and to shallow-rooted row, field, and specialty crops. Areas of deeper soils can be planted to pears or prunes.

Care is needed in irrigating this soil because of its restricted depth. Frequent, light applications of water help to keep a perched water table from forming and to avoid excessive runoff. Adequate surface drainage is needed. Rough leveling can be done if shallow cuts are made to fill minor swales. In this way exposing of the substratum can be avoided and plant growth maintained. Crops on this soil respond if fertilizer that contains nitrogen and phosphorus is applied. Adding chicken manure also benefits crops.

Capability Unit IVe-1

This unit consists of well drained and moderately well drained soils in the Arbuckle, Boomer, Cohasset, Goldridge, Goulding, Josephine, Kneeland, Kneeland sandy variant, Laniger, Red Hill, Rohnerville, Sebastopol, Sobrante, and Steinbeck series. These soils are on low foothills or moderately steep terraces. Slopes generally are 9 to 15 percent, but they range from 9 to 30 percent. The surface layer is sandy loam to clay loam and is gravelly in places. These soils are moderately deep or very deep. They formed in material derived from fine-grained sandstone and shale, soft sandstone, basic igneous rock, or mixed terrace material.

The total available water capacity ranges from about 2 to 11 inches. Reaction is very strongly acid to neutral. Fertility is moderately low to moderately high. The erosion hazard is slight to high.

Under careful management, all of these soils are suited to dryland and irrigated pasture, field crops, vineyards, and orchards. Apple orchards, for example, produce well on these soils. Some of the soils are well suited to timber production, but most such soils have already been cleared.

Keeping a cover of vegetation on these soils helps to control gullying and sheet erosion during the wet season, and farming on the contour slows runoff and thus reduces erosion. Sprinklers are better to use than other methods for applying irrigation water. A suitable cropping system includes field crops grown in sequence with such cover crops as pasture.

Capability Unit IVe-3

In this unit are well drained to somewhat poorly drained soils of the Clough, Cotati, Dibble, Haire, Huichica, Kinman, Los Osos, Noyo, Pleasanton, Positas, Spreckels, Tuscan, and Wright series. These soils have a surface layer of sandy loam to clay loam that is gravelly or cobbly in places. The subsoil is clay and is at a depth of 10 to 60 inches. Slopes generally are 9 to 15 percent, but they range to 30 percent. Also in this unit are some soils that are gently sloping but are subject to moderate erosion.

The total available water capacity is about 2.5 to 10 inches. Reaction is extremely acid to moderately alkaline. Fertility is low to moderately high. Permeability of the subsoil is slow to very slow. Roots of most cultivated crops penetrate to the clay subsoil, but perennial plants and some other plants penetrate to several feet into the subsoil. Few roots can penetrate to a depth of 5 feet.

These soils are suited to small grains and pasture. Vineyards and family orchards can be grown on the deeper soils.

Using a cropping system that includes cultivated crops 1 year out of every 5 or 6 years and doing all tillage on the contour help to control erosion. In addition, where these soils are irrigated, the water should be applied by low-volume sprinklers. Most of these soils tend to fix the existing phosphorus, and extra phosphorus is needed. Crops on these soils therefore generally respond if fertilizer that contains phosphorus and nitrogen is applied.

Capability Unit IVe-4

Felta very gravelly loam, 5 to 15 percent slopes, is the only soil in this unit. This well-drained soil is on terraces. It contains a considerable amount of gravel and stones. Depth to the underlying volcanic tuff and water-washed gravel ranges from 12 to 13 inches.

The available water capacity is 5 to 6.5 inches in this soil. Because of its high content of gravel, this soil tends to be droughty. Reaction is slightly acid in the surface layer and slightly acid to strongly acid in the substratum. Fertility and permeability are moderate.

This soil is used mainly for grazing. A few of the less steep areas can be cultivated and irrigated under careful management.

In places gravel hinders tillage of this soil, but the less gravelly areas can be seeded if proper equipment is used. All tillage should be done across the slope or on the contour. Grazing areas can be expanded by clearing the brushy undergrowth from carefully selected sites. Crops on this soil respond if fertilizer that contains nitrogen and phosphorous is applied.

Capability Unit IVe-5

In this unit are well-drained clays in the Diablo and Raynor series. These soils are on rounded hills. Slopes are 15 to 30 percent. The soils range from about 20 to 45 inches in depth, and roots readily penetrate to this depth.

The available water capacity in these soils ranges from about 4 to 8 inches. Reaction is slightly acid to moderately alkaline. Fertility is moderate to moderately high, and permeability is slow.

Under careful management that includes measures for the control of erosion, these soils are suited to limited use for field and forage crops. They are used mostly for pasture.

These soils are difficult to work because of their fine texture. Management of irrigation water also is difficult. Cultivating across the slope and keeping a protective cover of vegetation on the soils help to reduce the erosion hazard. Low-volume sprinklers are better to use than other methods for applying irrigation water.

Capability unit IVe-8

This unit consists of well-drained soils in the Goulding and Laughlin series. These soils are on broad ridgetops or on moderately steep hillsides. Slopes are 2 to 30 percent. The surface layer is loam or cobbly clay loam. Depth to hard bedrock ranges from 16 to 36 inches.

The total available water capacity in these soils ranges from 3 to 5 inches. Reaction is slightly acid to strongly acid. Fertility is low to moderate, and permeability is moderate.

These soils are better suited to grazing of annual grasses in spring and early in summer than to other uses. If grazing is controlled, enough plants remain to provide seed for growth during the next season.

Low available water capacity and shallowness to bedrock limit use of these soils for seed crops. If these soils are used for forage crops, cultivating on the contour helps to control erosion. In addition a cover of plants should be kept on these soils at least 5 years in 6. Because of the cobblestones cultivating the Goulding soil is difficult, and the cobblestones also reduce the amount of moisture available to plants.

Capability Unit IVw-3

In this unit are somewhat poorly drained soils in the Huichica and Wright series. These soils are on old bench terraces or flood plains. The surface layer is loam, and it ranges from 12 to 20 inches in thickness. It is underlain by a restricting layer of clay. These soils generally are nearly level, but they are gently sloping in hummocky areas where swales and drainageways are more numerous.

The total available water capacity is about 2 to 5 inches. Reaction is very strongly acid to moderately alkaline. Fertility is moderate. Permeability is very slow in the clay subsoil, and penetration of water and roots is restricted.

These soils are well suited to such shallow-rooted crops as pasture and hay. In places grapes grow fairly well on the Huichica soils. Most field, forage, and row crops are suited if suitable crop varieties are grown and if water is controlled. Tree crops are not suited.

Wetness is a continuing problem on these soils, and the soils are difficult to drain because of the clay subsoil. Ponding occurs in places during rainy periods. Dikes, levees, or diversions are needed to protect these soils from water flowing from adjacent areas.

Capability Unit IVw-9

Reyes silty clay, 0 to 2 percent slopes, is the only soil in this unit. This poorly drained soil is in low areas, where the surface is undulating and irregular. Generally layers of peat that range from thin to thick occur throughout the profile. In places small stringers of organic material extend from the surface to a depth of several feet. Erosion is not a hazard.

Reaction in the lower layers of this soil and in unreclaimed areas is pH 4 to 5.5. In places where the soil is drained and reclaimed and the soil is cultivated and allowed to dry and oxidize, reaction is pH 3.5 to 5.0. Some salt is in the soil in places, but fresh water from winter rains reduces or neutralizes the harmful effects of excess salt. Fertility is moderate. Runoff and permeability are slow. The water table generally is within a few feet of the surface.

This soil is suited only to small grains and forage plants that tolerate salts and acidity. The chief crop generally is oats grown for hay, though occasionally the oats are threshed for grain. This soil is fairly well suited to narrow-leaf trefoil. Growth of safflower is fair.

If this soil is drained, care is needed to reduce the water table only to the minimum depth suitable for shallow-rooted crops. This soil is difficult to rewet once it dries.

Capability Unit IVs-4

In this unit are excessively drained soils of the Cortina series. These stratified soils have a

surface layer of very gravelly sandy loam or very gravelly loam. The layers below are very gravelly coarse sand to very gravelly coarse sandy loam. The soils are more than 60 inches deep over recent alluvium. Slopes range from 0 to 2 percent. The soils are subject to deposition and removal of material by water.

The total available water capacity in these soils is about 2 to 5 inches. Reaction is medium acid to slightly acid. Fertility is low, and permeability is very rapid.

These soils are suited to vineyards, alfalfa, and irrigated pasture.

The major limitation of soils in this unit is their low available water capacity. Applying irrigation water lightly, but frequently, helps to reduce loss of water. Crops on these soils respond if fertilizer that contains nitrogen, phosphorus, and potassium is added in split applications.

Capability Unit VIe-1

In this unit are well drained to moderately well drained soils in the Boomer, Caspar, Cohasset, Empire, Goldridge, Goulding, Guenoc, Hely, Hugo, Josephine, Kneeland, Laniger, Mendocino, Red Hill, Sebastopol, Sites, Sobrante, and Steinbeck series. The surface layer of these soils ranges from sandy loam to sandy clay loam. Depth to the underlying sandstone, shale, or basic igneous rock ranges from 16 to 60 inches. Slopes range from 5 to 50 percent. Erosion is a hazard on all of the soils, but the soils that have slopes of 9 to 30 percent are more erodible than those that have slopes of 30 to 50 percent.

The total available water capacity in these soils is about 3 to 12 inches. Reaction is very strongly acid to neutral, and the soil becomes increasingly acid as depth increases. Fertility is moderately low to moderately high. Permeability in the subsoil is moderately rapid to moderately slow.

The Goulding, Guenoc, Kneeland, Laniger, Steinbeck, and Sobrante soils in this unit are suited to oak-grass range. The remaining soils are well suited to production of wood crops. In most places the plant cover consists of such coniferous trees as redwood and Douglas-fir and of such hardwoods as tan oak, live oak, madrone, and other broad-leaved trees.

Erosion is the major hazard to use of these soils. Limiting logging to the drier parts of the year helps to reduce the hazards of soil compaction and erosion. Other management practices for these soils are given in the sections "Use of the Soils for Range" and "Use of the Soils for Woodland."

Capability Unit VIe-3

This unit consists of moderately well drained and well drained soils in the Atwell, Clough, Cotati, Dibble, Haire, Kinman, Kneeland, Laughlin, Los Osos, Spreckels, Suther, Tuscan, and Yorkville series. These soils have a surface layer of sandy loam to clay loam and a subsoil of clay. Depth to the subsoil, to bedrock, or to a hardpan is 10 to 60 inches. Slopes are 5 to 30 percent.

The total available water capacity in these soils ranges from about 1.5 to 12 inches. Reaction is extremely acid to mildly alkaline. Fertility is moderately high to low. Permeability in the subsoil is slow or very slow.

Soils of this unit are well suited to pasture. They are not suited to cultivated crops, because of their slope and relatively high hazard of erosion. Douglas-fir and redwood grow fairly well on Atwell and Sites soils in this unit.

Keeping a cover of vegetation on these soils helps to keep them productive and to decrease the hazard of erosion. Under good management the range has a patchy appearance at the end of the grazing season as the result of seed production and regrowth. More detailed information on management is given in the sections "Use of the Soils for Range" and "Use of the Soils for Woodland."

Capability Unit VIe-4

In this unit are somewhat excessively drained to well drained soils of the Atwell, Baywood, Boomer, Felta, Hely, Hugo, Kneeland sandy variant, and Sheridan series. These soils are loamy sand to clayey loam in texture. They have a considerable amount of gravel and stone in places in the surface layer or throughout their profile. Many of the soils have slightly more clay in the subsoil than elsewhere in the profile, and they are underlain by volcanic tuff, fine-grained sandstone, or granodiorite. Depth of these soils ranges from 10 to 60 inches. Slopes are 9 to 50 percent.

The available water capacity is 2 to 8 inches in these soils. Reaction is neutral to strongly acid. Fertility is moderately low. Runoff is medium to rapid, and the erosion hazard is moderate to high.

These soils are used mainly as woodland or range. Some cleared areas of Hugo soils are eroded where improper logging methods have been used or too many animals have grazed.

Keeping a cover of plants on these soils helps to avoid excessive loss of soil during heavy rain. Forage plants generally respond to fertilizer that contains nitrogen, phosphorus, and sulfur. Other information on management is given in the sections "Use of the Soils for Range" and "Use of the Soils for Woodland."

Capability Unit VIe-5

In this unit are well-drained clays in the Cibo, Diablo, Montara, and Raynor series. These soils generally are in hilly areas. Slopes range from 15 to 50 percent. Depth to sandstone, shale, or gabbro is 25 to 55 inches.

The total available water capacity in these soils is 4 to 7 inches. Reaction is medium acid to moderately alkaline. Permeability is moderate to slow.

These soils are well suited to range. The plant cover consists of sparse stands of brush and a few oaks. The soils are not suitable for cultivation, because of their steep slopes and severe erosion hazard. Information about management of these soils for range is given in the section "Use of the Soils for Range."

Capability Unit VIe-8

This unit consists of well drained and somewhat excessively drained soils in the Forward, Goulding, Kidd, and Laughlin series. These soils have a surface layer of loam to clay loam that is stony or cobbly in places. The soils formed in material derived from hard sandstone, basic igneous rock, and acid igneous rock. Depth to hard bedrock ranges from 12 to 40 inches. Slopes range from 2 to 50 percent, but most of the soils have slopes of 15 to 30 percent.

The available water capacity in these soils ranges from 2 to 5 inches. Reaction is neutral to very strongly acid. Fertility is moderate to low. Permeability is moderate to rapid.

These soils are used for range. The vegetation generally is mostly annual grasses, though oaks grow in places. Perennial grasses grow in scattered areas, depending on the intensity of grazing in the past.

Many areas of these soils are overgrazed and are eroded. Controlling grazing helps to reduce erosion and provides a good part-time range. Range plants on these soils respond if fertilizer that contains nitrogen and phosphorus is applied. Other management practices for these soils are given in the section "Use of the Soils for Range."

Capability Unit VIw-5

Raynor clay, seeped, 2 to 15 percent slopes, is the only soil in this unit. This soil formed under good drainage, but it is now saturated with water late in spring and early in summer. It generally is 45 to 65 inches deep. Most areas of this soil consist of only a few acres.

The available water capacity in this soil is about 8 to 10 inches. Reaction is slightly acid to moderately alkaline. Fertility is moderately high. Permeability is slow.

Water grass, sedges, or other plants that tolerate wetness grow on most areas of this soil during the rainy season and late in spring. Such volunteer plants as annual rye, wild oats, and tarweed grow in this soil as it dries.

The main concerns of management are keeping stock away from marshy wet areas to avoid excessive puddling and preventing the formation of deep holes that catch water and could develop into gullies.

Capability Unit VIIe-1

This unit consists of well drained or moderately well drained soils in the Boomer, Cohasset, Comptche, Goulding, Guenoc, Hely, Josephine, Kneeland, Sites, Sobrante, and Supan series. These soils formed in material derived from sandstone, shale, and granitic rock. The surface layer ranges from sandy loam to clay loam, and some of the soils have rock fragments throughout the profile. Depth to fractured bedrock is 16 to more than 60 inches. Slopes range from 30 to 75 percent, but they are mainly 50 to 75 percent. The hazard of erosion is high to very high.

The available water capacity in these soils ranges from 3 to 10 inches. Reaction is very strongly acid to neutral, and acidity generally increases with increasing depth. Fertility is moderately low to moderately high. Permeability is moderate to moderately slow.

Soils in this unit are used chiefly for range, timber production, watershed, and wildlife habitat. The Goulding, Guenoc, Sobrante, and Supan soils are used mainly for oak-grass range. The other soils can be managed for production of wood crops. Generally the plant cover is redwood, Douglas-fir, and other conifers and such hardwoods as tanoak, live oak, madrone, and other broad-leaved trees. Limiting all logging to the drier seasons helps to reduce erosion and to avoid soil compaction.

Capability Unit VIIe-3

In this unit are well drained or moderately well drained soils in the Atwell, Laughlin, Los Osos, Suther, and Yorkville series. These soils have a surface layer of loam or clay loam. Depth to the clay subsoil is 14 to 55 inches. Slopes are 30 to 75 percent. The hazard of erosion is high to very high, and some areas are eroded.

The total available water capacity in these soils ranges from 2.5 to 11 inches. Fertility is moderate to moderately high. Reaction is very strongly acid to mildly alkaline. Permeability of the subsoil is moderate to very slow.

Trees grow fairly well on Atwell and Sites soils, but the other soils in this unit are used chiefly for range. The vegetation generally is grass and oak, but grass, oak, and other hardwoods grow in some areas.

Steep slopes and the hazard of further erosion make these soils poorly suited to cultivation. Also, overgrazing in many areas increases the hazard of gullying and erosion. Special care is needed in managing the Atwell, Los Osos, and Yorkville soils, for they are susceptible to landslips. Keeping a cover of plants on all soils in this unit helps to control erosion. The Suther soils can be improved for grazing by selective thinning of the underbrush.

Capability Unit VIIe-4

This unit consists of well-drained soils in the Atwell, Boomer, Felta, Hely, Hugo, Josephine, and Los Gatos series. These soils are on uplands. They have considerable gravel in the surface layer or throughout the profile. In most of the soils, the subsoil is well developed. Depth to the underlying soft or weathered volcanic tuff or fine-grained sandstone ranges from 12 to 40 inches. Slopes range from 30 to 75 percent. The soils are subject to erosion, and many areas are eroded.

Available water capacity in these soils is 3 to 5 inches. Reaction is strongly acid to neutral. Fertility is moderate, and permeability is moderate to very slow.

Most areas of these soils are used only as woodland or as range. Some areas are eroded because of improper logging or because of overgrazing on cleared areas. Keeping a cover of plants on these soils helps to avoid excessive soil loss during heavy rainstorms. Nearly all forage plants on these soils respond if fertilizer that contains nitrogen and phosphorus is applied. More information on management is given in the sections "Use of the Soils for Range" and "Use of the Soils for Woodland."

Capability Unit VIIe-7

Red Hill cobbly clay loam, 30 to 75 percent slopes, is the only soil in this unit. This soil is moderately well drained. Roots can penetrate to a depth of 30 to 50 inches. The hazard of erosion is high to very high.

The available water capacity in this soil is 4 to 6 inches. Reaction is medium acid to slightly acid. Fertility is moderately high, and permeability is moderately slow.

Fair stands of Douglas-fir and patches of redwood are on protected areas of this soil that are not subject to drying. Cleared areas are used for limited grazing.

Steep slopes and cobblestones make this soil poorly suited to cultivation. A permanent cover of plants is needed to help prevent excessive erosion. Information on management of the soils for woodland is given in the section "Use of the Soils for Woodland."

Capability Unit VIIe-8

In this unit are well drained to somewhat excessively drained soils of the Boomer, Forward, Goulding, Hugo, Josephine, Kidd, Laughlin, Los Gatos, Maymen, Stonyford, Toomes, and Yorkville series. These soils have a surface layer of loam or clay loam, and most of them are gravelly or cobbly or rocks crop out at the surface. Slopes range mostly from 30 to 75 percent, but some soils have slopes of less than 30 percent. Depth to hard bedrock is 5 to 48 inches.

The total available water capacity in these soils is about 1 to 8 inches. Reaction is very strongly acid to neutral. Fertility is moderately low to very low. Permeability is moderately slow to rapid.

These soils are used for range along with soils of capability unit VIe-8 that are interspersed within areas of these soils. The soils are so intermingled that separating the areas by fences is not practical. The vegetation is mostly grass and grass and oaks, but forbs, shrubs, and brush grow in some places. If the vegetation is repeatedly burned or overgrazed, brush encroaches on most of the soils. Additional information about the use and management of these soils is given in the section "Use of the Soils for Range."

Capability Unit VIIe-9

In this unit are well drained to excessively drained soils in the Henneke, Huse, and Montara series. These soils are on uplands. They have a surface layer of gravelly loam, stony clay loam, or cobbly clay loam. Depth to the underlying serpentine and ultrabasic rock ranges from 10 to 25 inches. Slopes range from 2 to 75 percent.

The total available water capacity in these soils ranges from 1 to 4 inches. Reaction ranges from slightly acid to moderately alkaline. Fertility is very low, and permeability is moderate to moderately slow.

These soils are used primarily for wildlife habitat and for recreational purposes, but they are used also for limited grazing.

The plant cover on these soils is brush and sparse stands of annual grasses and forbs. Improving the quality and quantity of the forage on these soils is impractical because of the very low fertility and the low ratio of calcium to magnesium. Other information on management is given in the section "Use of the Soils for Range."

Capability Unit VIIw-4

Only Alluvial land, sandy, is in this unit. It is nearly level and is excessively drained to moderately well drained. The soil material is gravelly or stony and is stratified because of repeated deposition. The areas are subject to flooding and to further deposition in winter and in spring. Some areas have a dense cover of plants that can tolerate wetness.

The total available water capacity varies, depending on the degree of stratification. Fertility is moderate to low, also depending on the degree of stratification.

Alluvial land, sandy, is used as range and as wildlife habitat. Woody areas can be cleared and used as vineyards and orchards if channel alinement and streambank protection are provided to protect adjacent areas from flooding and water erosion.

Capability Unit VIIs-8

Only Kidd very rocky loam, 30 to 75 percent slopes, is in this unit. This soil is somewhat excessively drained, and the hazard of erosion is high to very high. Depth to bedrock of hard rhyolite is 12 to 20 inches. Rock is exposed on about 10 to 25 percent of the surface of this soil.

The available water capacity is 2 to 3 inches. Reaction is slightly acid to medium acid. Fertility is low, and permeability is moderate.

This soil is used as range, wildlife habitat, and watershed. Protection from overgrazing and fires is needed to help prevent further erosion. Other information on management is given in the section "Use of the Soils for Range."

Capability Unit VIIIe-1

Only Gullied land is in this unit. This land type is in rough mountainous areas and is covered by brush. The areas are cut by gullies that formed naturally as drainageways developed. Misuse of the watershed, however, has caused excessive deepening of the drainageways and excessive cutting into the heads and banks of the drainageways. Slopes generally range from 10 to 75 percent or more.

Gullied land is not suited to farming. It is used for watershed, for wildlife habitat, and for recreational purposes.

Preventing and suppressing fires on this land type help to control erosion and also help to protect the soils downstream. The gullies can be kept from enlarging by proper stocking and control of grazing on upstream range and pasture.

Capability Unit VIIIe-4

Only Dune land is in this unit. This land type is made up of well-graded sand. Reaction ranges from medium acid to mildly alkaline.

Dune land is used chiefly for recreation. The dunes can be stabilized by mechanical means or by vegetation to help prevent the blowing of sand onto adjacent soils and waterways. European beachgrass generally is planted first. Nearly all of the sand dunes between Bodega Bay and Salmon Creek, for example, are now planted to this grass and movement of sand across the Bodega Bay area has nearly ceased.

Capability Unit VIIIw-2

Only Tidal marsh is in this unit. The lower areas of this land type are flooded daily, but the higher areas are flooded only during unusually high tides. The adjacent soils are slightly higher than Tidal marsh and their many channels are periodically flushed by tidewater. Tidal marsh generally is fine textured, but in places it contains many strata of sandy or organic material.

This land type is strongly saline. Reaction ranges from slightly acid to strongly alkaline. Permeability is slow to very slow.

Tidal marsh produces no forage, but it is suitable for recreational use and wildlife habitat.

Some areas of Tidal marsh that are not protected by dikes are flooded by tidewater twice a day. More areas are reclaimed each year by use of dikes, drainageways, and flood gates. As a result, many areas are now producing good crops of oats, hay, and grain. Onsite investigation is necessary to determine if the cost of reclamation is feasible and if it is practical to reclaim an area.

Capability Unit VIIIw-4

This unit consists of barren, sandy, gravelly, or stony deposits in stream channels and on beaches along the coast. Some areas are subject to frequent flooding and deposition, and the beaches are subject to the continuous action of wind and waves.

These mapping units are suitable only for recreational uses and for wildlife habitat. Channel alinement and streambank protection are the chief measures needed for conserving soil and water.

Capability Unit VIIIs-8

This unit consists of rough, rocky, mountainous areas and of steep escarpments along the coast. The areas are covered by brush. The soil material generally is less than 10 inches deep to rock, and rock crops out in many places. Slopes generally range from 30 to more than 75 percent.

The land types in this unit are not suitable for farming. They are used for watershed, for wildlife habitat, and for recreation areas.

Preventing and suppressing fires on these land types are needed for conserving soil and water and to help protect the soils downstream.

Estimated Yields[3/]

In table 2 estimated yields of the principal crops grown in Sonoma county are given. These estimates are based on observations made by soil scientists who surveyed the county, on information furnished by farmers, and on data from the Agricultural Extension Service, Soil Conservation Service, and the Sonoma County Agricultural Commissioner. Federal and county census records on crop data were also reviewed and considered. More information was available for some soils of the county than for others. If little information was available about the yield on a particular kind of soil, estimates were made by comparing that soil with a similar one.

The yields in table 2 are for crops grown under a high level of management. This is the level of

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[3/] By JACK E. WOODS, area conservationist, Soil Conservation Service.

TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF PRINCIPAL CROPS UNDER A HIGH LEVEL OF MANAGEMENT

[No estimates are given for soils on which a particular crop is not grown or for soils to which a crop is not suited]

Soil	Apples	Pears	Prunes	Grapes	Walnuts	Oats		Corn silage	Irrigated pasture	Dryland pasture
						Hay	Grain			
	Tons	Tons	Tons	Tons	Tons	Tons	Pounds	Tons	Animal-unit-months 1/	Animal-unit-days 2/
Alluvial land, clayey	20	25	5	8	-----	3	2,500	25	16	80
Arbuckle gravelly sandy loam, 0 to 5 percent slopes	20	25	4	8	-----	3	2,500	--	16	40
Arbuckle gravelly sandy loam, 5 to 15 percent slopes	20	25	4	8	-----	3	2,500	--	16	40
Arbuckle gravelly sandy loam, 15 to 30 percent slopes	20	25	4	8	-----	2.5	2,000	--	12	20
Arbuckle gravelly loam, 0 to 5 percent slopes	20	25	4	8	-----	3	2,500	--	16	40
Arbuckle gravelly loam, 5 to 9 percent slopes	20	25	4	8	-----	3	2,500	--	16	40
Baywood loamy sand, 2 to 9 percent slopes	--	--	--	--	-----	--	-----	--	--	40
Blucher fine sandy loam, overwash, 0 to 2 percent slopes	--	--	--	--	-----	2.5	2,000	25	12	120
Blucher loam, 0 to 2 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Blucher loam, 2 to 5 percent slopes	--	--	--	--	-----	3	2,500	25	12	120
Blucher clay loam, 0 to 2 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Blucher clay loam, 2 to 5 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Boomer loam, 15 to 30 percent slopes	20	25	4	8	1,500	--	-----	--	12	40
Clear Lake clay loam, 0 to 2 percent slopes	--	--	4	--	-----	3	2,500	25	16	120
Clear Lake clay loam, 2 to 5 percent slopes	--	--	4	--	-----	3	2,500	25	16	120
Clear Lake clay, 0 to 2 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Clear Lake clay, 2 to 5 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Clear Lake clay, ponded, 0 to 2 percent slopes	--	--	--	--	-----	2.5	-----	25	16	120
Clough gravelly loam, 2 to 9 percent slopes	--	--	2	4	-----	2.5	-----	--	12	20
Clough gravelly loam, 9 to 15 percent slopes	--	--	2	4	-----	2.5	-----	--	12	40
Cohasset gravelly loam, 15 to 30 percent slopes	--	--	--	--	-----	--	-----	--	--	40
Cole silt loam, 0 to 2 percent slopes	20	25	4	8	-----	3	2,500	--	16	120
Cole silt loam, 2 to 5 percent slopes	20	25	4	8	-----	3	2,500	--	16	120
Cole clay loam, 0 to 2 percent slopes	20	25	4	8	-----	3	2,500	--	16	120
Cole clay loam, 2 to 5 percent slopes	20	25	4	8	-----	3	2,500	--	16	120
Cortina very gravelly sandy loam, 0 to 2 percent slopes	20	25	4	8	-----	--	-----	--	12	20
Cortina very gravelly loam, 0 to 2 percent slopes	20	25	4	8	-----	--	-----	--	12	20

TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF PRINCIPAL CROPS UNDER A HIGH LEVEL OF MANAGEMENT--Continued

Soil	Apples	Pears	Prunes	Grapes	Walnuts	Oats: Hay	Oats: Grain	Corn silage	Irrigated pasture	Dryland pasture
	Tons	Tons	Tons	Tons	Tons	Tons	Pounds	Tons	Animal-unit-months 1/	Animal-unit-days 2/
Cotati fine sandy loam, 2 to 9 percent slopes-----------	--	--	--	--	-----	2.5	2,000	--	12	60
Cotati fine sandy loam, 9 to 15 percent slopes----------	--	--	--	--	-----	2.5	2,000	--	12	60
Diablo clay, 2 to 9 percent slopes---------------------	--	--	--	--	-----	3	2,500	--	16	120
Diablo clay, 9 to 15 percent slopes---------------------	--	--	--	--	-----	3	2,500	--	16	120
Diablo clay, 15 to 30 percent slopes---------------------	--	--	--	--	-----	3	2,500	--	16	120
Diablo clay, 15 to 30 percent slopes, eroded-------------	--	--	--	--	-----	--	-----	--	16	120
Dibble clay loam, 2 to 9 percent slopes----------------	--	25	2	4	-----	3	2,500	--	16	60
Dibble clay loam, 9 to 15 percent slopes----------------	--	--	--	--	-----	--	-----	--	16	60
Felta very gravelly loam, 5 to 15 percent slopes-----------	--	--	--	--	-----	--	-----	--	--	20
Goldridge fine sandy loam, 2 to 9 percent slopes---------	30	30	5	15	-----	3	2,500	25	16	120
Goldridge fine sandy loam, 9 to 15 percent slopes--------	30	30	5	15	-----	3	2,500	25	16	120
Goldridge fine sandy loam, 9 to 15 percent slopes, eroded---------------------	20	25	4	8	-----	2.5	2,000	20	12	80
Goulding clay loam, 5 to 15 percent slopes-------------	--	--	--	--	-----	2.5	-----	--	12	40
Goulding clay loam, 15 to 30 percent slopes-------------	--	--	--	--	-----	2.5	-----	--	12	40
Haire fine sandy loam, hummocky, 0 to 5 percent slopes---------------------	--	--	--	--	-----	2.5	2,000	--	12	60
Haire gravelly loam, 0 to 9 percent slopes-------------	--	25	2	8	-----	3	2,500	--	16	80
Haire gravelly loam, 9 to 15 percent slopes-------------	--	25	2	8	-----	3	2,500	--	16	80
Haire gravelly loam, 9 to 15 percent slopes, eroded------	--	25	2	8	-----	3	2,500	--	16	80
Haire clay loam, 0 to 9 percent slopes----------------	--	25	2	8	-----	3	2,500	--	16	80
Haire clay loam, 9 to 15 percent slopes----------------	--	25	2	8	-----	3	2,500	--	16	80
Haire clay loam, 9 to 15 percent slopes, eroded---------	--	25	2	8	-----	3	2,500	--	16	80
Huichica loam, 0 to 2 percent slopes---------------------	--	25	4	4	-----	2	-----	--	12	60
Huichica loam, 2 to 9 percent slopes---------------------	--	25	4	4	-----	2	-----	--	12	60
Huichica loam, 9 to 15 percent slopes---------------------	--	25	4	4	-----	2	-----	--	12	60
Huichica loam, ponded, 0 to 5 percent slopes-------------	--	20	2	3	-----	2	-----	--	12	60
Huichica loam, shallow, 0 to 9 percent slopes-------------	--	--	2	3	-----	2	-----	--	10	40

TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF PRINCIPAL CROPS UNDER A HIGH LEVEL OF MANAGEMENT--Continued

Soil	Apples	Pears	Prunes	Grapes	Walnuts	Oats		Corn silage	Irrigated pasture	Dryland pasture
						Hay	Grain			
	Tons	Tons	Tons	Tons	Tons	Tons	Pounds	Tons	Animal-unit-months 1/	Animal-unit-days 2/
Huichica loam, shallow, ponded, 0 to 5 percent slopes	--	--	2	3	-----	2	-----	--	10	40
Kinman loam, 5 to 15 percent slopes	--	--	--	--	-----	2.5	-----	--	12	80
Kneeland loam, 5 to 9 percent slopes	--	--	--	--	-----	2	-----	--	--	60
Kneeland loam, 9 to 15 percent slopes	--	--	--	--	-----	2	-----	--	--	60
Laniger loam, 5 to 9 percent slopes	--	--	--	--	-----	2	-----	--	--	20
Los Osos clay loam, 2 to 15 percent slopes	--	--	--	--	-----	3	2,500	--	--	120
Los Osos clay loam, 15 to 30 percent slopes	--	--	--	--	-----	3	2,500	--	--	120
Los Robles gravelly clay loam, 0 to 2 percent slopes	30	30	5	15	1,500	3	2,500	--	16	120
Los Robles gravelly clay loam, moderately deep, 0 to 5 percent slopes	30	30	5	15	1,500	3	2,500	--	16	120
Manzanita gravelly silt loam, 0 to 9 percent slopes	30	30	5	15	1,500	3	5,000	--	16	120
Pajaro fine sandy loam, 0 to 2 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Pajaro fine sandy loam, 2 to 5 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Pajaro gravelly loam, 0 to 5 percent slopes	--	20	--	8	-----	3	2,500	25	16	120
Pajaro clay loam, overwash, 0 to 2 percent slopes	--	--	--	--	-----	2.5	2,000	25	12	120
Pajaro clay loam, overwash, 2 to 5 percent slopes	--	--	--	--	-----	2.5	200	25	12	120
Pleasanton loam, 0 to 2 percent slopes	30	30	5	15	1,500	3	2,500	--	16	120
Pleasanton loam, 2 to 9 percent slopes	30	30	5	15	1,500	3	2,500	--	16	120
Pleasanton gravelly loam, 2 to 5 percent slopes	30	30	5	15	1,500	3	2,500	--	16	120
Pleasanton clay loam, 2 to 5 percent slopes	20	25	4	8	-----	3	2,500	--	16	80
Pleasanton gravelly clay loam, 2 to 9 percent slopes	20	25	4	8	1,500	3	2,500	--	16	80
Positas gravelly loam, 0 to 9 percent slopes	--	25	4	8	-----	2.5	-----	--	16	80
Positas gravelly loam, 9 to 15 percent slopes	--	25	4	8	-----	2.5	-----	--	16	60
Red Hill clay loam, 2 to 15 percent slopes	20	25	4	8	-----	2.5	2,000	--	12	40
Red Hill clay loam, 15 to 30 percent slopes	20	25	4	8	-----	2.5	2,000	--	12	40
Reyes silty clay, 0 to 2 percent slopes	--	--	--	--	-----	3	2,500	--	--	80
Rohnerville loam, 0 to 9 percent slopes	--	--	--	--	-----	2.5	-----	--	12	80

TABLE 2.--ESTIMATED AVERAGE ACRE YIELDS OF PRINCIPAL CROPS UNDER A HIGH LEVEL OF MANAGEMENT--Continued

Soil	Apples	Pears	Prunes	Grapes	Walnuts	Oats		Corn silage	Irrigated pasture	Dryland pasture
						Hay	Grain			
	Tons	Tons	Tons	Tons	Tons	Tons	Pounds	Tons	Animal-unit-months 1/	Animal-unit-days 2/
Rohnerville loam, 9 to 15 percent slopes	--	--	--	--	-----	2.5	-----	--	12	80
Sebastopol sandy loam, 2 to 9 percent slopes	30	30	5	15	-----	3	2,500	--	16	120
Sebastopol sandy loam, 9 to 15 percent slopes	30	30	5	15	-----	3	2,500	--	16	120
Sebastopol sandy loam, 9 to 15 percent slopes, eroded	20	25	4	8	-----	2.5	2,000	--	12	80
Spreckels loam, 2 to 9 percent slopes	--	--	--	--	-----	2.5	-----	--	12	40
Spreckels loam, 9 to 15 percent slopes	--	--	--	--	-----	2.5	-----	--	12	40
Steinbeck loam, 2 to 9 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Steinbeck loam, 9 to 15 percent slopes	--	--	--	--	-----	3	2,500	25	16	120
Steinbeck loam, 9 to 15 percent slopes, eroded	--	--	--	--	-----	2.5	-----	--	12	80
Tuscan cobbly clay loam, 0 to 9 percent slopes	--	--	--	3	-----	--	-----	--	--	20
Wright loam, 0 to 9 percent slopes	--	--	4	3	2,000	2.5	-----	--	12	60
Wright loam, wet, 0 to 2 percent slopes	--	25	2	8	-----	2.5	-----	--	12	60
Wright loam, shallow, 0 to 5 percent slopes	--	--	2	3	-----	2	-----	--	10	40
Wright loam, shallow, wet, 0 to 2 percent slopes	--	--	--	--	-----	2	-----	--	10	40
Yolo sandy loam, 0 to 2 percent slopes	30	30	5	15	2,500	3	2,500	25	16	120
Yolo sandy loam, overwash, 0 to 5 percent slopes	30	30	5	15	2,500	3	2,500	25	16	120
Yolo loam, 0 to 2 percent slopes	30	30	5	15	2,500	3	2,500	25	16	120
Yolo loam, overwash, 0 to 5 percent slopes	30	30	5	15	2,500	3	2,500	25	16	120
Yolo gravelly loam, 0 to 5 percent slopes	30	30	5	15	2,500	3	2,500	25	16	120
Yolo silt loam, 0 to 2 percent slopes	30	30	5	15	2,500	3	2,500	25	16	120
Yolo clay loam, 0 to 2 percent slopes	30	30	5	15	2,500	3	2,500	25	16	120
Zamora silty clay loam, 0 to 2 percent slopes	20	30	5	8	2,000	3	2,500	25	16	120
Zamora silty clay loam, 2 to 5 percent slopes	20	30	5	8	2,000	3	2,500	25	16	120

1/ An animal-unit-month is the amount of forage or feed required to maintain one animal unit for a period of 30 days.

2/ An animal-unit-day is the number of animal units carried per acre multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod.

management that, according to experience, field trials, and research findings, gives the highest possible return. High-level management includes the use of irrigation.

The yields in table 2 are estimated, and they are averages that can be expected over a period of years. Trees and vines are assumed to be mature, in full production, and in an optimum stand. Only standard varieties of wine grapes were considered, because premium varieties generally are less productive. Variations among the soils in depth that roots can penetrate, water-holding capacity, and drainage also were considered.

Sonoma County has a long growing season and a wide variety of soils. For these reasons, many crops other than the principal ones listed in table 2 are grown. About 25 different kinds of commercial crops were grown in the county in 1964.

Several fruits not listed in table 2 are grown on a small scale. These include cherries, peaches, plums, boysenberries, blueberries, strawberries, and citrus.

Oats and vetch are grown for annual hay on about 25,000 acres. Oats planted alone is harvested for grain on about 12,000 acres. The acreage in these crops fluctuates from year to year, depending on the demands for hay or grain. The Reyes and Clear Lake soils in the southern part of the county are used primarily to grow oats for grain and hay.

Corn for silage is grown to provide feed for dairy cattle on about 1,200 acres in the county, mostly on Pajaro, Steinbeck, and Yolo soils. Irrigating and fertilizing are necessary for satisfactory yields of this crop.

Winter cover crops are commonly grown in orchards and vineyards. Some cover crops are seeded to oats and vetch; others are made up of annual grasses, legumes, and forbs. Where soil fertility is maintained at an adequate level, there is no difficulty in obtaining a good volunteer cover crop. Cover crops are reduced by mowing or disking in March and April after the danger of heavy rains has passed.

Fertilizer, insecticides, fungicides, and soil amendments are required for successful operation of orchards and vineyards.

Storie Index Rating

The soils of the county are listed in alphabetic order in the "Guide to Mapping Units" at the back of the survey and rated according to the Storie index (22). This index expresses numerically the relative degree of suitability, or value, of a soil for general intensive farming. The rating is based on soil characteristics only. It does not take into account other factors, such as availability of water for irrigation, climate, and distance from markets, which might determine the desirability of growing specific crops in a given locality. For these reasons, the index, in itself, cannot be considered an index for land valuation.

Four factors that represent the inherent characteristics and qualities of the soil are considered in the index rating. Each factor is rated or evaluated separately in terms of percentage of the ideal, or 100 percent. The factors are:

Factor A, Profile characteristics. Factor A expresses relative suitability of a profile for the growth of plant roots. Soils that have deep permeable profiles are rated 100 percent. Those that have a dense layer of clay or a hardpan or are shallow to bedrock are rated less than 100 percent. The rating depends upon the extent to which root penetration is limited.

Factor B, Texture of the surface soil. Factor B is rated according to the texture of the surface soil, which affects the ease of tillage and the capacity of the soil to hold water. The moderately coarse and medium textures--fine sandy loam, loam, and silt loam--are the most desirable and are rated as 100 percent. The coarser and finer textures, such as sand and clay, are rated less than 100 percent.

Factor C, Slopes. Factor C is particularly important if the soil is irrigated. The amount of water that runs off a soil and its susceptibility to erosion are influenced by the slope of the soil. Smooth, nearly level or very gently sloping soils are rated 100 percent. The rating decreases as the slope increases.

Factor X, Other conditions. Factor X is used to evaluate any limitations to use of the soil, such as poor drainage or a high water table, erosion, salts or alkali, low fertility, acidity, or unfavorable microrelief. If more than one limitation exists, the values of each are multiplied together to get the X factor.

The index rating of a soil is obtained by multiplying the four factors, A, B, C, and X; thus, any one factor may dominate or control the final rating. For example, a soil may have an excellent profile justifying a rating of 100 percent for factor A, excellent texture of the surface soil justifying 100 percent for factor B, a smooth, nearly level surface justifying 100 percent for factor C, but a high accumulation of salts or alkali that would give a rating of 20 percent for factor X. Multiplying these four ratings gives an index rating of 20 for this soil. The high accumulation of salts or alkali dominates, makes the soil unproductive for crops, and justifies the low index rating of 20.

Soils are placed in grades according to their suitability for agricultural use as shown by their Storie index ratings. The six grades and their range in index ratings are--

	Index rating
Grade 1	80 to 100
Grade 2	60 to 80
Grade 3	40 to 60
Grade 4	20 to 40
Grade 5	10 to 20
Grade 6	Less than 10

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Soils of grade 1 have few or no limitations that restrict their use for crops. Soils of grade 2 are suitable for most crops, but they have minor limitations that narrow the choice of crops and have few special management needs. Grade 3 soils are suited to a few crops or to special crops and require special management. Grade 4 soils are severely limited for crops. If used for crops, they require careful management. Grade 5 soils are not suited to cultivated crops but can be used for pasture and range. Grade 6 consists of soils and land types that generally are not suited to farming.

Use of the Soils for Range [4/]

About 312,000 acres, or about 30 percent of the total acreage in Sonoma County are used for range. Generally the soils used for range are not suited to cultivation. Forage production can be increased, however, in selected areas by adding fertilizer, controlling brush, and seeding adapted grasses and legumes.

Several hundred ranches are in the county, and they range from 100 to 12,000 acres in size. The number of cattle ranges from 70,000 to 75,000. It varies according to the type of operation, such as cow-calf or stocker, or according to seasonal growing conditions. The cattle numbers are greatest from October through May during the green-feed period. Sheep numbers range from 115,000 to 120,000 the season long.

Many of the livestock operations depend on natural vegetation for year long feed. When the range forage is low in protein in summer and early in fall, a supplement can be fed. Hay of oats or oats and vetch generally is grown in the dry arable soils that occur on some ranches. It is fed to the cattle to supplement the range forage. In years when the supply of moisture is favorable, the forage on the more gently sloping soils is harvested for hay.

Weather conditions, particularly the timeliness of the precipitation during the growing season, cause seasonal range forage to vary considerably. If the supply of moisture is unfavorable, considerable amounts of hay and protein supplement are needed. Many ranches must buy hay from distant markets at an excessive cost. Little irrigated hay is produced because of lack of irrigation water, or because the rancher chooses to use the water on the arable soils for cash crops that bring a high price.

Most of the important forage plants in the county are introduced. The original forage plants were perennials and annuals, but the introduced plants are mainly annuals. Remnant perennials still grow, however, in places at the higher elevations and on coastal grassland areas. The amount of forage they produce is small compared to that produced by the annuals.

On range that is properly managed for annuals, the perennials persist and some of them increase in number. The perennials have a more extensive root system than the annuals and obtain moisture below the surface for growth late in the season. They provide palatable green feed after the annuals have matured. The annuals rely on the moisture that is available, grow rapidly, produce highly nutritious feed during the green and growing period, set seed, and mature by the time the available moisture is gone. Adequate residue from these plants must be left on the surface as a mulch, for the quality and quantity of the forage produced in any one season depends on the residue that was left the prior season.

Climate has a significant effect on the production of the annual vegetation in the higher areas, but it has less effect in the coastal areas. The amount of forage produced varies as much as 100 percent for the same range site between years of favorable moisture and years of unfavorable moisture. Differences in distribution of rainfall and in temperature in fall, winter, and spring can cause even greater fluctuations in plant growth. The kind of plants that grow also is influenced by climate. Burclover, for example, makes up a large part of the plant composition, particularly in the finer textured soils, in years when precipitation comes early and is well distributed throughout the growing season and mild temperatures prevail. If moisture is available and soil temperatures are high, ripgut brome germinates. Other kinds of plants need lower temperatures for germination.

Range Sites

The soils used for grazing in Sonoma County have been grouped into range sites. Each site differs from the others in its ability to produce significantly different kinds and amounts of vegetation and in the management needed to keep the site in good condition. Important changes in the kinds of grasses often take place gradually. They can be overlooked by an operator who is not familiar with his range plants and soils. If the range operator knows the different kinds of soil in his holdings and the plants each kind is capable of growing, he can then manage the range to favor the best forage plants on each kind of soil.

Management of grazing is needed to encourage a desirable mixture of annual plants. Livestock graze selectively, and they seek out the palatable and nutritious plants. If grazing is not carefully regulated, the more desirable plants are weakened or eliminated. Less desirable plants then increase. If grazing pressure continues, the less desirable plants are thinned out or eliminated and undesirable, unpalatable plants take their place or the soil is left bare. Assistance in determining initial stocking rates can be obtained from local representatives of the Soil Conservation Service and from farm advisers of the University of California.

In the pages that follow, brief descriptions of the twelve range sites in Sonoma County are given.

4/ By CHANDLER V., JENSEN AND ROCHE D. BUSH, range specialists, Soil Conservation Service.

Annual air-dry production is estimated for each site. These estimates are based on a limited number of clippings, and on knowledge of the soils in the sites. The estimated annual yields of forage are for unfertilized range. These yields vary according to the precipitation received, and extremes in weather can cause even greater fluctuation in production.

The names of soil series are given in each range site, but this does not mean that all the soils in a series are in the range site. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this survey.

1. Loamy Uplands

This site consists of loams to clay loams in the Dibble, Goulding, Guenoc, Los Osos, Rohnerville, and Steinbeck series. These soils are well drained and moderately well drained. Depth to weakly cemented layers, sandstone, or basic rock ranges from 14 to 60 inches. Slopes range from 0 to 50 percent, but they are dominantly 15 to 30 percent. Elevation ranges from 100 to 2,500 feet. The annual precipitation is 20 to 50 inches. Many areas of these soils are eroded.

The available water capacity is 3 to 8 inches. Permeability is moderate to slow. In some of the soils the subsoil is clayey, and moisture is slowly available to plants. Reaction is strongly acid to neutral. Fertility is moderate to moderately high.

Typically these soils have a cover of grass or of grass and oak. The vegetation is mostly annual grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, wild oats, stipa, California brome, blue wildrye, burclover, filaree, annual clover, and Spanish clover. About 20 percent of the vegetation is less desirable kinds of plants, such as ripgut brome, red brome, annual fescue, wild barley, squirreltail, and annual lupine. The rest consists of medusahead, dogtail grass, nitgrass, silver hairgrass, tarweed, popcornflower, fiddleneck, turkeymullein, thistle, and other undesirable plants. In poor condition this site contains a few less desirable plants, but undesirable plants are dominant. Large acreages of this site have been invaded by heavy growth of medusahead.

The soils of this site are well suited to seeding of improved annual forage plants if the vegetative cover is in poor condition. They are also suited to seeding of hardinggrass where an adequate seedbed can be prepared. Forage plants on these soils repond well if fertilizer is applied. Clearing is feasible where brush has invaded on this site.

The total estimated annual air-dry production on this site is 3,200 pounds per acre in years of favorable moisture and 1,600 pounds per acre in years of unfavorable moisture.

2. Claypan

This site consists of coarse sandy loams to clay loams in the Cotati, Haire, Kinman, Noyo, Sebastopol, Spreckels, Suther, and Yorkville series. These soils have a subsoil of clay. They are well drained to somewhat poorly drained. Depth to very slowly permeable clay or to shale or sandstone ranges from 20 to more than 60 inches. Slopes range from 0 to 30 percent, but they are dominantly more than 15 percent. Elevation ranges from 100 to 3,000 feet. The annual precipitation is 25 to 70 inches. Landslips are common on this site.

The available water capacity is 2 to 10 inches. Permeability is slow to very slow. Reaction is very strongly acid to neutral in the surface layer, and extremely acid to mildly acid in the subsoil. Fertility is low to moderately high.

Typically these soils have a cover of grass or of grass and oak, though brush grows in places on slopes that face north. The vegetation is mostly annual grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, wild oats, ryegrass, filaree, Spanish clover, annual clovers, a small amount of burclover, and remnants of perennial grasses. About 20 percent of the vegetation is less desirable kinds of plants, such as ripgut brome, red brome, wild barley, annual fescue, wild carrot, and annual lupine. The rest consists of medusahead, dogtail grass, silver hairgrass, nitgrass, plantain, thistle, fiddleneck, tarweed, popcornflower, wild mustard, and other undesirable plants.

The soils of this site are well suited to seeding of hardinggrass where an adequate seedbed can be prepared. They are also well suited to improved annual grasses and legumes. Forage plants on these soils respond well if fertilizer is applied. Little brush has invaded on this site, but clearing is feasible where brush has invaded.

The total estimated annual air-dry production on this site is 3,000 pounds per acre in years of favorable moisture and 1,500 pounds per acre in years of unfavorable moisture.

3. Clayey Hills

This site consists of well-drained clays in the Cibo, Diablo, Laughlin, and Raynor series. Depth to basalt, sandstone, or shale ranges from 20 to 60 inches. These soils are subject to erosion if a good cover of grass is not maintained, and some areas are eroded. Slopes range from 2 to 50 percent. Elevation ranges from 200 to 2,500 feet. The annual precipitation is 22 to 60 inches.

The available water capacity is 4 to 10 inches. Permeability is slow. Reaction generally is slightly acid to moderately alkaline in the surface layer and moderately alkaline in the substratum. Fertility is moderately high to moderate.

Typically these soils have a cover of grass or of grass and oak, though dense thickets of oak grow in places on slopes that face north. The vegetation is mostly annual grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, ryegrass, remnants of perennial grasses, filaree, annual clover, and excellent stands of burclover and wild oats. About 20 percent of the vegetation is less desirable kinds of plants, such as ripgut brome, wild barley, annual fescue, red brome, wild carrot, and annual lupine. The rest consists of medusahead, nitgrass, dogtail grass, tarweed, fiddleneck, popcornflower, vinegar weed, turkeymullein, thistle, mustard, and other undesirable plants. In poor condition this site contains some less desirable plants, but undesirable plants are dominant.

The soils of this site are well suited to seeding hardinggrass where an adequate seedbed can be prepared. They are also suited to improved annual grasses and legumes. Forage plants on these soils respond well if fertilizer is applied. Little brush has invaded on this site, but clearing is feasible where brush has invaded.

The total estimated annual air-dry production on this site is 3,600 pounds per acre in years of favorable moisture and 1,800 pounds per acre in years of unfavorable moisture.

4. Shallow Loamy Uplands

This site consists of loams to gravelly loams and of clay loams to cobbly clay loams in the Clough, Felta, Forward, Goulding, Laniger, Laughlin, Los Osos, and Sobrante series. These soils are well-drained and moderately well drained. Depth to basic rock, fine-grained sandstone, or volcanic tuff ranges from 16 to 60 inches. Slopes range from 2 to 50 percent, but they are dominantly 15 to 30 percent. Elevation ranges from 200 to 3,500 feet. The annual precipitation is 20 to 70 inches. Some areas of these soils are eroded.

The available water capacity is 2 to 7 inches. Permeability is mainly moderate, but in some of the soils it is slow or very slow. Reaction is very strongly acid to neutral. Fertility is low to moderate.

Typically these soils have a cover of grass or of grass and oak, though brush grows in places on slopes that face north. The vegetation is mostly grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, wild oats, remnants of perennial grasses, filaree, burclover, annual clover, Spanish clover, and annual lupine. About 20 percent of the vegetation is less desirable kinds of plants, such as annual fescue, ripgut brome, wild barley, wild carrot, yarrow, and lupine. The rest consists of nitgrass, silver hairgrass, dogtail grass, popcornflower, fiddleneck, tarweed, and thistle. In poor condition this site contains a few less desirable plants, but undesirable plants are dominant. Large acreages of this site now have a cover of thick to very thick stands of blue oak and live oak and are producing less forage than their potential.

The production of forage can be improved by thinning the trees and removing the brush on this site. After clearing, or if the plant cover is in poor condition, the soils are well suited to seeding of improved annual grasses and legumes. Forage plants on these soils respond well if fertilizer is applied, but increases in forage are less than on deeper soils.

The total estimated annual air-dry production on unfertilized soils of this site is 2,400 pounds per acre in years of favorable moisture and 1,200 pounds per acre in years of unfavorable moisture.

5. Steep Loamy

This site consists of loams, clay loams, and gravelly silt loams in the Dibble, Goulding, Guenoc, Steinbeck, and Supan series. These soils are well drained and moderately well drained. Depth to sandstone or basic rock ranges from 14 to 55 inches. In a few places rocks crop out. Slopes are mostly 30 to 50 percent, but they range to 75 percent. Elevation ranges from 300 to 3,000 feet. The annual precipitation is 20 to 60 inches. Some areas are eroded, and landslips are common on some of the soils.

Available water capacity is 3 to 7 inches. Permeability is moderate to slow. Reaction is strongly acid to neutral, and fertility is low to moderately high.

Typically these soils have a cover of grass or of grass and oak, though pockets of dense oak and brush grow in places on slopes that face north. The vegetation is mostly annual grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, wild oats, stipa, California brome, blue wildrye, burclover, filaree, annual clover, and Spanish clover. About 20 percent of the vegetation is less desirable kinds of plants, such as ripgut brome, red brome, annual fescue, wild barley, squirreltail, and annual lupine. The rest consists of dogtail grass, nitgrass, silver hairgrass, tarweed, popcornflower, fiddleneck, turkeymullein, thistle, and other undesirable plants. In poor condition this site contains a few less desirable plants, but undesirable plants are dominant. Large areas of this site now have a cover of thick to very thick stands of blue oak and live oak and are producing less forage than their potential.

The production of forage can be improved by thinning the trees and removing the brush on this site, particularly on the less sloping soils. Because of the steep slopes, seeding and fertilizing should be done only to control erosion.

The total estimated annual air-dry production on this site is 3,000 pounds per acre in years of favorable moisture and 1,500 pounds per acre in years of unfavorable moisture.

6. Steep Claypan

This site consists of loams and clay loams in the Kinman, Spreckels, Suther, and Yorkville series. These soils have a subsoil of clay. They are moderately well drained and well drained. Depth to shale, sandstone, or basic rock ranges from 20 to 60 inches. Slopes range from 15 to 75 percent, but they are dominantly 30 percent and more. Elevation ranges from 100 to 3,000 feet. The annual precipitation is 25 to 70 inches. Landslips are common on this site.

The available water capacity is 3 to 12 inches. Permeability is slow or very slow. Reaction is medium acid to slightly acid in the surface layer and strongly acid to mildly alkaline in the subsoil. Fertility is moderate to moderately high.

Typically these soils have a cover of grass or of grass and oak, though brush grows in places on slopes that face north. The vegetation is mostly annual grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, wild oats, ryegrass, filaree, Spanish clover, annual clovers, and small amounts of burclover and remnants of perennial grasses. About 20 percent of the vegetation is less desirable kinds of plants, such as ripgut brome, red brome, wild barley, annual fescue, wild carrot, and annual lupine. The rest consists of medusahead, dogtail grass, silver hairgrass, nitgrass, plantain, thistle, fiddleneck, tarweed, popcornflower, wild mustard, and other undesirable plants.

Little brush has invaded on this site, and clearing is not needed in most places. Because of the steep slopes, seeding and fertilizing should only be done for control of erosion.

The total estimated annual air-dry production on this site is 2,800 pounds per acre in years of favorable moisture and 1,600 pounds per acre in years of unfavorable moisture.

7. Steep Clayey

This site consists of well-drained clays in the Diablo series. Depth to soft sandstone or shale ranges from 25 to 60 inches. These soils are subject to erosion unless a good cover of grass is kept on the range, and some areas are eroded. Slopes range from 30 to 50 percent. Elevation ranges from 200 to 1,200 feet. The annual precipitation is 22 to 35 inches. Landslips are likely to occur on the these soils.

The available water capacity is 4 to 8 inches. Permeability is slow. Reaction is slightly acid to moderately alkaline in the surface layer and moderately alkaline in the subsoil. Fertility is moderately high.

Typically these soils have a cover of grass or of grass and oak, though oak and brush grow in places on slopes that face north. The vegetation is mostly annual grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, ryegrass, remnants of perennial grasses, filaree, annual clover, and excellent stands of burclover and wild oats. About 20 percent of the vegetation is less desirable kinds of plants, such as ripgut brome, wild barley, annual fescue, wild carrot, and annual lupine. The rest consists of nitgrass, dogtail grass, tarweed, fiddleneck, popcornflower, vinegarweed, turkey mullein, thistle, mustard, and other undesirable plants. In poor condition this site contains some less desirable plants, but undesirable plants are dominant.

Little brush has invaded on this site, and clearing is not needed in most places. Seeding and the applying of fertilizer are feasible.

The total estimated annual air-dry production on this site is 3,300 pounds per acre in years of favorable moisture and 1,800 pounds per acre in years of unfavorable moisture.

8. Steep Shallow Loamy Uplands

This site consists of clay loams to cobbly clay loams or loams to very gravelly loams in the Felta, Forward, Goulding, Laniger, Laughlin, Los Osos, and Sobrante series. These soils are well drained to moderately well drained. Depth to basic rock, rhyolite, tuff, sandstone, or shale ranges from 12 to 30 inches. Slopes are dominantly 30 to 75 percent, but they are less than 30 percent in some areas. Elevation ranges from 300 to 4,000 feet. The annual precipitation is 20 to 70 inches.

The available water capacity is 2 to 5 inches. Permeability is mainly moderate. In some of the soils, the subsoil is clay or gravelly clay and moisture is slowly available to plants. Reaction is very strongly acid to neutral. Fertility is low to moderate.

Typically these soils have a cover of grass or of grass and oak, though in a few areas dense stands of oak or of oak and brush grow in places on slopes that face north. The vegetation is mostly annual grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, wild oats, remnants of perennial grasses, filaree, burclover, annual clover, Spanish clover, and annual lupine. About 20 percent of the vegetation is less desirable kinds of plants, such as annual fescue, ripgut brome, wild barley, wild carrot, yarrow, and lupine. The rest consists of nitgrass, silver hairgrass, dogtail grass, popcornflower, fiddleneck, tarweed, and thistle. In poor condition this site contains a few less desirable plants, but undesirable plants are dominant. Large acreages of this site now have a cover of dense to very dense stands of blue oak and live oak and are producing less forage than their potential.

Clearing of brush and thinning of trees on selected areas helps make the better areas of the range more accessible. Because of the steep slopes, seeding and fertilizing should be done only for control of erosion.

The total estimated annual air-dry production on this site is 2,200 pounds per acre in years of

favorable moisture and 1,000 pounds per acre in years of unfavorable moisture.

9. Shallow Rocky

This site consists of loams and cobbly clay loams in the Goulding, Toomes, and Tuscan series. These soils are well drained. Depth to bedrock or hardpan ranges from 5 to 25 inches. Rocks crop out on 3 to 10 percent of the surface of these soils. Slopes range from 0 to 75 percent. Elevation ranges from 200 to 2,500 feet. The annual precipitation is 25 to 50 inches.

The available water capacity is 1 to 3 inches. Reaction is medium acid to slightly acid. Fertility is low.

Typically these soils have a cover of grass or grass and oak, though shrubs grow in varying amounts in places. The vegetation is mostly grasses, forbs, and brush. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, wild oats, remnants of perennial grasses, annual clover, filaree, and small amounts of burclover. About 20 percent of the vegetation is less desirable kinds of plants, such as annual fescue, wild barley, ripgut brome, red brome, wild carrot, yarrow, and poison oak. The rest consists of nitgrass, false brome, tarweed, soapweed, prickly phlox, popcornflower, goldfields, and other undesirable plants. In poor condition this site contains a few less desirable plants, but undesirable plants are dominant.

It is not economically feasible to control brush, to seed, or to apply fertilizer on the Toomes soils, except to control erosion or where emergency measures are needed. The Tuscan soils respond to seeding and to fertilizer.

The total estimated annual air-dry production on this site is 1,800 pounds per acre in years of favorable moisture and 800 pounds per acre in years of unfavorable moisture.

10. Very Shallow

This site consists of stony loams, gravelly loams, and gravelly sandy loams of the Boomer, Forward, Josephine, Kidd, Los Gatos, Maymen, and Stonyford series. The gravelly loams and gravelly sandy loams have up to 50 percent gravel throughout their profile. The soils in this site are well drained to excessively drained. Depth to sandstone, shale, greenstone, or rhyolite ranges from 5 to 48 inches. Slopes range from 2 to 75 percent, and large acreages have slopes of more than 50 percent. Elevation ranges from 800 to 4,000 feet. The annual precipitation is 25 to 70 inches.

The available water capacity is 1 to 7 inches. Fertility is low to very low. Reaction is strongly acid to slightly acid.

Typically these soils have a cover of brush, grass, and oak, though a few small areas consist of open grassland. The vegetation is mostly moderately thick to very thick stands of brush, blue oak, and live oak that have an understory of annual grasses and forbs. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, filaree, and annual clover. About 20 percent of the vegetation is less desirable kinds of plants, such as annual fescue, wild barley, annual lupine, and wild carrot. The rest consists of undesirable plants of the understory, such as dogtailgrass, nitgrass, and silver hairgrass. The predominant woody plants are blue oak, live oak, toyon, chamise, manzanita, yerba santa, and digger pine.

Because these soils are shallow to rock, it is not feasible to improve the vegetation by clearing the soil, seeding, or applying fertilizer, except to control erosion or where emergency measures are needed. Kidd stony loam responds to seeding and to fertilizer.

The total estimated annual air-dry production on this site is 1,600 pounds per acre in years of favorable moisture and 600 pounds per acre in years of unfavorable moisture.

11. Serpentine Land

This site consists of gravelly loams and stony or cobbly clay loams of the Henneke, Huse, and Montara series. These soils are well drained to excessively drained. Depth to serpentine bedrock generally is 8 to 25 inches. Slopes range from 0 to 75 percent. Elevation ranges from 600 to 3,500 feet. Annual precipitation is 30 to 60 inches.

Available water capacity is 1.5 to 4 inches. Reaction is slightly acid to moderately alkaline. Fertility is very low. Because of the large amount of coarse fragments on the surface, erosion generally is not severe.

Typically these soils have a cover of brush, grass, and oak. The vegetation is mostly annual and perennial grasses and forbs that occur around and under scattered kinds of brush. If the vegetation is producing at potential, about 50 percent is such desirable plants as soft chess, many remnants of perennial grasses, wild oats, filaree, annual clover, and Spanish clover. About 35 percent of the vegetation is less desirable kinds of plants, such as ripgut brome, wild barley, red brome, annual lupine, wild carrot, yarrow, and poison oak. The rest consists of undesirable kinds of plants, such as nitgrass, silver hairgrass, owl's clover, goldfields, popcornflower, tarweed, and vinegarweed. The predominant brush and trees are chamise, manzanita, yerba santa, toyon, deer vetch, digger pine, Oregon oak, and live oak. In poor condition this site contains a few less desirable plants, but undesirable plants are dominant. Attempts to improve the cover on this site should be made only if the need for forage is critical.

The total estimated annual air-dry production on this site is 1,200 pounds per acre in years of favorable moisture and 500 pounds per acre in years of unfavorable moisture.

12. Coastal Terrace Uplands

This site consists of soils in the Kinman and Kneeland series and in the Kneeland sandy variants. These soils have a surface layer of loam, sandy loam, or rocky loam. The subsoil is clay loam. Depth to soft sandstone ranges from 20 to 45 inches. Slopes range from 2 to 75 percent, but they are dominantly more than 30 percent. Elevation ranges from 100 to 1,500 feet. The annual precipitation is 30 to 40 inches.

The available water capacity is 4 to 7 inches. Reaction is medium acid in the surface layer and subsoil. Fertility is moderate.

Typically these soils have a cover of grass, though some shrubs grow on the breaks and at the heads of waterways. The vegetation consists of annual and perennial grasses, annual forbs, and of a small amount of grasslike plants in the waterways and on seep areas. If the vegetation is producing at maximum, about 70 percent is such desirable plants as soft chess, rye grass, wild oats, stipa, blue wildrye, spike bentgrass, dryland sedges, coastal reed grass, filaree, and annual clover. About 20 percent of the vegetation is less desirable kinds of plants, such as annual fescue, wild barley, ripgut brome, annual lupine, and yarrow. The rest consists of dogtail grass, dock, plantain, pearly everlasting, iris, ferns, and other undesirable plants. In the waterways and draws are dense stands of low trees and shrubs that are inaccessible to livestock.

The Kneeland loams that have slopes from 5 to 30 percent and the Kneeland variants can be cleared, seeded, and fertilized to increase the forage. On the other soils these practices should be done only for controlling erosion or for other critical reasons.

The total estimated annual air-dry production on this site is 2,200 pounds per acre in years of favorable moisture and 1,500 pounds per acre in years of unfavorable moisture.

Use of the Soils for Woodland [5/]

More than half of Sonoma County, or about 553,000 acres, is in woodland. According to a study made in 1952 (27), 46 percent of the acreage in woodland is noncommercial. The remaining acreage, or about 292,000 acres, supports commercial stands of timber. Most of the woodland is privately owned, though small acreages are owned by public agencies. Redwood, Douglas-fir, oaks, and other miscellaneous hardwoods are the main kinds of trees.

Logging began early in Sonoma County. The third sawmill constructed in California was located in the County on the Russian River. It operated through the mid 1800's. The lumber produced was shipped by water to large coastal towns such as San Francisco. Production was small, but it increased after the San Francisco earthquake in 1906 to supply the wood needed to rebuild the city. Production then declined until World War II. During the period of low production the wooded areas were used for recreation.

During World War II and after, production increased from a few million board feet a year to more than 200 million board feet. In 1962, 22 sawmills and 37 wood manufacturing plants were operating in the county. The stands of Douglas-fir and redwood are used mainly to produce lumber, though a part of the timber harvested is used for pulp. Some of the woodland has been converted to recreational use because of nearness to densely populated centers and because of the pleasant summer climate.

Soil, climate, and relief are all important in determining tree growth and the kinds of trees that make up the woodland. Redwood grows mainly near the coast where the precipitation is supplemented by frequent coastal fogs in summer. Along the coast a common coniferous associate is Douglas-fir. Further inland, where summer temperatures are higher, the occurrence of redwood decreases as the distance from the Pacific Ocean increases. Here Douglas-fir is dominant in the stands, and associated hardwoods are such trees as tan oak, black oak, interior live oak, and madrone. The types of forest cover (21) in the county are Coast Douglas-fir, redwood, Oregon oak, oak and madrone, ponderosa pine and Douglas-fir, California black oak, canyon live oak, and Digger pine and oak. The relief in the northwestern part of the county where most timber is produced consists of mountain ranges and of steep narrow valleys along the coast. The location of the trees is shown on soil vegetation maps available from the Division of Forestry, State of California (6).

Douglas-fir has a higher site index in the fog belt than on soils of comparable depths outside the belt (32). Total rainfall and elevation also affect site quality. The range of site quality within a given mapping unit varies because of the effect of such factors as soil depth, aspect, slope, rainfall, location in reference to the fog belts, and elevation.

Redwood grows best and the trees are largest in small narrow areas of alluvial soils adjacent to streams. Where the specific climate requirements for each species are met, redwood and Douglas-fir are on the heavily faulted and folded marine sandstones and shales of the Franciscan formation. In general, the deeper soils have the greatest growth potential for these trees because they retain more moisture for tree growth over a longer time. They also permit development of a normal root system.

Protection from grazing, from fire, and from insects and disease are needed for the trees in the woodland to grow well and to provide maximum benefits in conserving soil and water. After logging is done, many of the woodlands are grazed for several years. If grazing is permitted during the rainy season or if the areas are overgrazed, restocking of the trees is likely to be delayed. As a result, the harvesting of trees is delayed and the number of trees that can be harvested is reduced.

[5/] By ROBERT A. DELLBERG, woodland specialist, Soil Conservation Service.

Fire protection for the woodlands is provided by the California Division of Forestry. This Division also supervises compliance with practices needed to provide protection from fire. During the long, hot, dry part of the year, fire protection problems are severe. Consequently, prompt effective action is needed to control wildfires.

Insect attacks generally are in small scattered areas. For Douglas-fir build-up of insect populations to the point where damage is significant is generally associated with trees that have been blown down, logging slash, and fire damage, all of which provide a favorable habitat for the insects. Two bark beetles that attack Douglas-fir (17) are the Douglas-fir beetle (Dendroctonus pseudotsugae), and the Douglas-fir engraver (Scolytus unispinosus). Two diseases of the stem of Douglas-fir are white pocket rot (Fomes pini) and red brown butt rot (Polyporus schweinitzii). Common points of infection for these fungi that cause the wood to rot are branch stubs, wounds, and fire scars.

Some insects that attack redwood (11) are the flat-headed borer (Anathaxia aeneogaster) and the round-headed borers (Callidium sempervirens, Callidium pallidum, Leptura obliterata, Prionus Californicus). The redwood bark beetle (Phloesinus sequoiae) attacks weakened redwood trees.

Woodland Groups

The soils in Sonoma County that are used mostly for wood crops have been placed in woodland suitability groups on the basis of soil characteristics that affect the growth of trees. Each group is made up of soils that require similar management practices and that have about the same potential productivity for wood crops. The names of the soils in each woodland group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

In each woodland group, first the characteristics of the soils are described. Then the estimated production potential in terms of site index is given. After that commercial trees growing on the soils are listed, and ratings for certain limitations or hazards that affect management are discussed.

In the paragraphs that follow, an explanation of site index and of the ratings of management hazards are given. Then each woodland group is discussed. The site index ratings in the discussion of each group are based on measurements in the field and on experience and judgment of woodland conservationists, foresters, landowners, and soil scientists. The measurements were made on even aged, fully stocked, unmanaged stands where possible. If stands did not exist or were not adequate for site determination, comparison with similar sites was used to determine the site index. In grouping the soils it was necessary to include small acreages of soils that have a range of depth. Thus, the site index shown represents the general productive capacity of the soils, but some variation can be expected. All ratings are tentative and are subject to revision as more information becomes available.

SITE INDEX. Site index is the height, in feet, of dominant and codominant, free-growing trees of a given species at a specified age.

The average annual per acre yield at specified ages for well-stocked, even-aged, unmanaged stands of Douglas-fir and of redwood are given in tables 3 and 4, respectively. The site index of redwood was determined by comparison with Douglas-fir (4). No site determinations were made for hardwoods. The data in the tables and in the woodland groups can be used by the landowner to determine the productivity of his soil for wood crops and to guide him in selecting the proper use of his land.

LIMITATIONS AND HAZARDS. Certain factors that affect the production of timber are related to the soils. Four such factors considered in Sonoma County are seedling mortality, plant competition, windthrow hazard, and equipment limitation. These factors are rated as to whether the limitation is slight, moderate, or severe. They are explained in the paragraphs that follow.

Seedling mortality refers to the expected degree of mortality of seedlings as a result of soil qualities. Mortality is slight if ordinarily adequate natural regeneration takes place; moderate if natural regeneration cannot always be relied on for immediate and adequate natural regeneration; and severe if much replanting, special seedbed preparation, and superior planting techniques are needed to assure adequate restocking. Distance from the cooling effects of the Pacific Ocean affects seedling mortality as does aspect. Seedling mortality generally increases with distance from the ocean. Mortality also increases on slopes that face south.

Plant competition refers to the degree of competition that can be expected from undesirable trees, shrubs, vines, and other plants that invade the site. A rating of slight means that competition from other plants is no special problem; of moderate, that plant competition develops but generally does not prevent an adequate stand of desirable trees from becoming established; and of severe, that plant competition prevents satisfactory establishment and growth of desirable kinds of trees. In this county competition from brush and from hardwoods of low quality increases with distance from the ocean. Also plant competition is more severe on slopes that face south than on those that face north.

Windthrow hazard is an evaluation of soil characteristics that affect development of tree roots and the firmness with which the roots anchor the tree in the soil so that they resist the force of the wind. The windthrow hazard is slight if no trees are expected to be blown down in commonly occurring winds; moderate if root development is adequate except for periods of greatest wind velocity; and severe if the depth of tree rooting is not adequate to provide windfirmness in moderate winds. Windthrow hazard is greatest near the shore where storms accompanied by high wind sweep in from the ocean.

Equipment limitations, or the relative trafficability of the soils, is discussed for each group. Drainage, slope, and other soil characteristics can

TABLE 3.--STAND AND YIELD PER ACRE FOR A WELL-STOCKED, EVEN-AGED UNMANAGED STAND OF DOUGLAS-FIR
[Based on data from USDA Tech. Bul. 201 (16)]

Site index	Age	Total merchantable volume			Average height of dominant and codominant trees	Average diameter at breast height	Basal area	Trees
	Year	Cubic feet	Board feet (scribner) 1/	Board feet (International) 1/	Feet	Inches	Square feet	Number
110	20	870	0	0	29	2.2	81	3,069
	30	2,270	0	0	50	3.9	122	1,472
	40	3,560	200	200	66	5.5	153	927
	50	4,780	3,300	3,900	77	7.0	177	659
	60	5,880	8,100	9,600	86	8.5	195	500
	70	6,830	14,000	16,500	94	9.8	211	405
	80	7,690	20,100	23,500	100	10.9	224	345
120	20	990	0	0	31	2.6	86	2,324
	30	2,630	0	0	55	4.4	129	1,219
	40	4,150	1,200	1,400	72	6.1	162	798
	50	5,540	5,500	6,500	84	7.7	187	572
	60	6,880	12,500	14,700	93	9.3	207	439
	70	8,000	20,600	24,100	102	10.8	224	352
	80	9,000	28,600	33,100	109	12.0	238	303
130	20	1,120	0	0	34	3.0	89	1,815
	30	2,980	0	0	60	4.9	135	1,030
	40	4,690	2,600	3,100	78	6.8	170	680
	50	6,300	8,400	9,900	91	8.5	196	496
	60	7,760	18,000	21,100	101	10.2	217	380
	70	9,100	27,900	32,400	110	11.8	235	310
	80	10,240	37,000	42,600	118	13.1	249	266
140	20	1,250	0	0	37	3.4	92	1,460
	30	3,300	300	400	64	5.5	140	865
	40	5,250	4,500	5,400	84	7.4	177	585
	50	7,050	12,400	14,600	98	9.3	204	430
	60	8,700	23,800	27,800	109	11.1	226	337
	70	10,150	35,200	40,600	119	12.8	244	274
	80	11,350	45,700	52,200	127	14.3	259	232
150	20	1,380	0	0	39	3.8	95	1,210
	30	3,610	900	1,100	69	6.0	144	735
	40	5,750	6,500	7,700	90	8.0	182	510
	50	7,730	17,000	20,000	105	10.1	210	377
	60	9,490	29,600	34,300	117	12.0	232	296
	70	11,060	42,500	48,700	127	13.8	251	242
	80	12,400	54,300	61,600	136	15.4	266	207
160	20	1,490	0	0	42	4.2	97	1,012
	30	3,880	1,500	1,800	74	6.5	147	640
	40	6,100	9,000	10,600	96	8.7	186	445
	50	8,300	22,200	26,000	112	10.9	214	331
	60	10,200	36,200	41,700	124	12.9	237	261
	70	11,900	50,000	57,000	135	14.8	256	214
	80	13,360	62,100	70,000	145	16.6	271	182

1/ Stand 12 inches in diameter at head height.

TABLE 4.--STAND AND YIELD PER ACRE FOR A WELL-STOCKED, EVEN-AGED UNMANAGED STAND OF REDWOOD

[Based on data from Calif. Agr. Expt. Sta. Bul. 796 (15)]

Site index	Age at breast height	Volume of trees 4.5 inches or more diameter breast height 1/	Volume of trees 10.5 inches or more diameter breast height 2/	Average annual volume increase of all trees 10.5 inches or more diameter breast height	Average total height of dominant trees	Average diameter at breast height 3/	Basal area 3/	Trees 3/
	Year	Cubic feet	Board feet	Board feet	Feet	Inches	Square feet	Number
100	20	200	0	0	21	7.6	50	159
	30	500	900	30	34	9.6	86	170
	40	1,000	2,800	70	47	11.3	127	182
	50	2,100	7,300	146	57	12.7	176	200
	60	3,600	14,400	239	67	14.1	224	207
	70	5,200	22,800	326	76	15.5	264	202
	80	6,900	32,400	405	85	16.8	299	194
120	20	450	600	30	31	8.7	75	180
	30	1,050	3,100	103	48	11.1	122	182
	40	2,300	8,800	220	62	13.0	169	184
	50	3,800	16,500	330	73	14.6	218	187
	60	5,820	27,400	455	84	16.2	267	186
	70	8,000	40,400	578	94	17.6	307	182
	80	10,140	53,700	671	104	18.9	342	175
140	20	1,000	2,300	115	42	9.3	103	219
	30	2,500	9,500	316	62	12.4	162	194
	40	4,500	20,400	510	76	14.6	217	186
	50	6,800	33,700	674	89	16.4	266	181
	60	9,220	48,900	812	102	18.0	315	178
	70	11,750	65,000	929	112	19.4	355	173
	80	14,190	81,500	1,019	123	20.8	390	165
160	20	2,270	7,000	350	53	10.1	140	251
	30	4,400	19,600	653	76	13.7	216	211
	40	7,250	36,900	922	92	16.2	280	195
	50	10,100	55,300	1,106	106	18.2	330	182
	60	12,960	74,500	1,237	119	19.9	379	175
	70	15,880	94,500	1,351	130	21.4	419	168
	80	18,640	114,300	1,429	142	22.8	454	160

1/ Top 4.0 inches, inside bark, stump 1.5 feet.

2/ International 1/4 inch rule, top 8.0 inches, inside bark, stump 1.5 feet.

3/ Stand 4.5 inches diameter breast height.

restrict the use of ordinary equipment in pruning, thinning, harvesting, or other woodland management. Equipment used during the rainy season when the soils are saturated causes soil compaction and possible root damage at times. A rating of slight means there is no restriction in the kind and size of equipment that can be used; moderate, that there is a limitation on the kind and size of the equipment that can be used when the soil moisture is at field capacity; and severe, that the size of equipment and the time of use must be limited to reduce soil loss or damage, as well as damage to the residual stand.

Woodland Group 1

In this group are soils of the Boomer, Cohasset, Empire, Forward, Hugo, Josephine, Mendocino, Red Hill, and Sites series. These soils are 30 to more than 60 inches deep. Their surface layer is loam, clay loam, sandy clay loam, or gravelly loam. They are underlain by igneous and sedimentary rock. Permeability is moderate to moderately slow. Available water capacity is 5 to 10 inches. Slopes range from 2 to 30 percent.

The site index on the soils in this group is 130 for Douglas-fir and 110 for redwood. On Mendocino sandy clay loam, 9 to 30 percent slopes, however, the site index is about 25 points higher. Coast Douglas-fir and redwood are the commercial forest types that grow on these soils.

Seedling mortality ranges from slight to severe. It is slight on Empire loam, 9 to 30 percent slopes, but on all other soils in this group seedling mortality is moderate to severe.

Plant competition is slight to moderate. Removal of competing hardwoods aids in the restocking of desirable conifers.

The windthrow hazard is slight on these soils. Equipment limitations are severe. Crawler tractors can be used in harvesting for about 7 months during the dry season without damaging the soils. Roads in the woods need adequate cross drains during the wet season to reduce the hazard of soil erosion.

Woodland Group 2

This group consists of soils of the Boomer, Caspar, Empire, Hely, Hugo, Josephine, and Mendocino series. These soils are 20 to more than 60 inches deep. Their surface layer is loam, very gravelly loam, silt loam, and sandy clay loam. They are underlain by igneous and sedimentary rock. Permeability is moderately slow to moderate. The available water capacity is 3.5 to 10 inches. Slopes are 30 to 50 percent.

The site index ranges from 120 to 140 for Douglas-fir on the soils of this group, and it is 110 for redwood. The site index for Mendocino sandy clay loam, 30 to 50 percent slopes, is about 20 points higher. Coast Douglas-fir and redwood are the commercial forest types that grow on these soils.

Seedling mortality is slight on Empire loam, 30 to 50 percent slopes. It ranges from moderate to severe on the other soils. Plant competition is slight to moderate. The windthrow hazard is moderate on Empire loam, 30 to 50 percent slopes, but it is slight on the other soils. Equipment limitations are severe to moderate on soils of this group.

Woodland Group 3

Soils in this group are in the Boomer, Comptche, Hely, and Josephine series. These soils are 20 to 60 inches deep. Their surface layer is loam, gravelly loam, and silt loam. They are underlain by igneous and sedimentary rock. Permeability is moderately slow to moderate. The available water capacity is 4 to 10 inches. Slopes range from 30 to 75 percent.

The site index is 110 to 130 for Douglas-fir on the soils in this group, and it is 110 for redwood. Coast Douglas-fir and redwood are the commercial forest types that grow on these soils.

Seedling mortality is moderate on these soils. Plant competition is severe on Comptche gravelly loam, 30 to 75 percent slopes, but it is moderate on the rest of the soils. The windthrow hazard is slight. The steep slopes make equipment limitations severe.

Woodland Group 4

In this group are soils of the Caspar and Goldridge series. These soils are 40 to more than 60 inches deep. Their surface layer is sandy loam and fine sandy loam. They are underlain by sedimentary rock. Permeability is moderately slow to moderate. Available water capacity is 7 to 10 inches. Slopes are 2 to 30 percent.

The site index is 126 for Douglas-fir on the soils of this group, and it is 110 for redwood. Redwood and Coast Douglas-fir are the commercial forest types that grow on these soils.

Seedling mortality and plant competition are slight on Caspar sandy loam, 15 to 30 percent slopes, but they are moderate on the other soils. The windthrow hazard and equipment limitations are also moderate.

Woodland Group 5

Soils in this group are of the Casper, Cohasset, and Goldridge series. These soils are 28 to more than 60 inches deep. Their surface layer is loam, sandy loam, fine sandy loam, and gravelly loam. Cohasset gravelly loam, 30 to 50 percent slopes, is underlain by igneous rock, but the other soils in this group are underlain by sedimentary rock. Permeability is moderately slow to moderate. Available water capacity is 5 to 9 inches. Slopes are 30 to 50 percent.

The site index is 126 for Douglas-fir on the soils in this group, but it is 110 for redwood. Redwood and Coast Douglas-fir are the commercial forest types that grow on these soils. Ponderosa pine occurs on Cohasset gravelly loam, 30 to 50 percent slopes. Douglas-fir, however, is the preferred species on Hugo loam, 30 to 50 percent slopes, providing the climate is favorable.

Seedling mortality is slight on Caspar sandy loam, 30 to 50 percent slopes, but it is moderate to severe on the other soils. Plant competition and windthrow hazard are slight to moderate. Equipment limitations are severe.

Woodland Group 6

In this group are soils of the Hugo and Josephine series. These soils are 30 to 40 inches deep. The surface layer is very gravelly loam. These soils are underlain by hard sedimentary rock. Permeability is moderate. Available water capacity is 4.5 to 5 inches. Slopes are 50 to 75 percent. Some of the soils are eroded.

The site index is 126 for Douglas-fir on the soils in this group, and it is 110 for redwood. Coast Douglas-fir and redwood are the commercial forest types that grow on soils in this group.

Plant competition is moderate to severe on these soils. Seedling mortality is severe. The windthrow hazard is slight, and equipment limitations are severe.

Woodland Group 7

This group consists of soils of the Red Hill and Sites series. These soils are 30 to more than 60 inches deep. Their surface layer is loam to clay loam. They are underlain by igneous or sedimentary rock. Permeability is moderately slow. Available water capacity is 5 to 10 inches. Slopes are 30 to 50 percent.

The site index is 120 for Douglas-fir on the soils in this group. Coast Douglas-fir and redwood are the commercial forest types that grow on soils in this group.

Seedling mortality and plant competition are moderate. Windthrow hazard is slight, and equipment limitations are severe.

Woodland Group 8

In this group are soils of the Atwell series. These soils are 22 to 50 inches deep. Their surface layer is clay loam. Permeability is very slow. The available water capacity is 5 to 8 inches. Slopes are 30 to 75 percent.

The site index is 140 for Douglas-fir on the soils in this group, and it is 120 for redwood. Coast Douglas-fir and redwood are the commercial forest types that grow on this site.

Seedling mortality is moderate on these soils. Plant competition and windthrow hazard are severe. Because of soil instability equipment limitations are severe. Harvesting must be done with care to control soil losses, and roads should not be constructed unless they are essential.

Woodland Group 9

This group consists of soils of the Cohasset, Forward, and Red Hill series. These soils are 20 to 50 inches deep. Their surface layer is cobbly clay loam and gravelly loam. They are underlain by igneous rock. Permeability is moderate to moderately slow. The available water capacity ranges from 4 to 6 inches, depending on depth. Slopes are 30 to 75 percent.

The site index is 110 for Douglas-fir on the soils in this group, but it is about 10 points higher for the Red Hill soil. Coast Douglas-fir is the commercial forest type that grows on soils in this group, though ponderosa pine grows in places on the Cohasset soil.

Seedling mortality is moderate to severe on these soils. Plant competition is slight to severe, and windthrow hazard is slight. The equipment limitation is severe, mainly because of the slope.

Wildlife [6/]

Game and fish are important in Sonoma County for the recreational opportunity they provide for hunting and fishing. Many kinds of wildlife, however, are also beneficial in control of undesirable rodents and insects. Others eat weed seeds that hinder growth of farm crops.

The Columbian black-tailed deer is the only big game animal of significance in the county. Ducks, band-tailed pigeons, valley and mountain quail, mourning doves, ring-necked pheasants, black-tailed jack rabbits, brush rabbits, gray squirrels, and a few wild pigs and turkeys live in the county. Nongame birds in the county range from the bald eagle to the hummingbird in size.

Steelhead are the most important game fish in the Russian River and in other inland streams. Silver salmon, shad, striped bass, rainbow trout, black bass, bluegills, and red-eared sunfish also are plentiful. Salmon, halibut, rock, abalone, and other fish are taken in the surf of the Pacific Ocean off the shore of the county.

Suitability of the soils for various kinds of wildlife varies according to the depth of the soil, its slope and texture, the stones and rocks present, the drainage, and the available water capacity. Location and position on the landscape are also important.

[6/] By WENDELL MILLER, biologist, SCS, assisted by VERNON MILLER, soil scientist, SCS.

The soils that provide suitable habitat for wildlife have been placed in eight wildlife groups according to the suitability of the soils for growth of plants important in developing habitat for wildlife. Considered in making these groupings were kinds of wildlife for which habitat could be developed for recreation or to provide an economic return. Only the kinds of wildlife that provide hunting or fishing were considered.

Suitability of the wildlife groups for various kinds of plants is shown in table 5. Also shown in table 5 is suitability of the various plants listed for use by stated kinds of wildlife. The plants listed in the table are food plants that occur widely in the county; or that have a high value for one or more kinds of wildlife and are suitable for use in more than one wildlife group; or are readily available and can readily be grown for wildlife use. The list is not intended to be a complete list of food plants available in the county. Choice food plants used by only one species of wildlife or that grow on the soils of only one group are listed in the text.

The wildlife groups are discussed in the pages that follow. The soils in each group can be determined by referring to the "Guide to Mapping Units" at the back of this survey.

Wildlife Group 1

This group consists of reclaimed areas of Reyes soils and of the land type Tidal marsh. These soils are adjacent to San Pablo Bay, along the creeks and sloughs that empty into the bay, and in similar areas along the Pacific Ocean. The surface layer is silty clay, and it contains varying amounts of organic matter. Soils in this group are poorly drained to very poorly drained. Permeability is moderately slow to very slow. Runoff is very slow, and water ponds in some places. Reaction is moderately alkaline to strongly acid.

On Tidal marsh where levees have not been constructed, the vegetation is mostly pickleweed and other plants that tolerate salt, such as saltgrass, California cordgrass, saltmarsh bulrush, and wiregrass. On the reclaimed soils where levees have been constructed, the cover consists of oats and of oats and vetch hay on the cultivated areas; annual ryegrass and trefoil on pasture; and pickleweed and saltmarsh bulrush on the soils used for duck clubs. The cover furnishes habitat for waterfowl, mainly ducks; shorebirds, such as gulls and herons; and songbirds, such as meadowlarks, blackbirds, and sparrows. A few white-tailed kites also frequent the areas.

Lack of dense cover in winter and fresh water in summer make the soils in this group only marginally suited to plants that provide habitat for ring-necked pheasant and California quail. The area generally is excessively wet in winter. Poor production of food, unfavorable water conditions caused by high soil salinity or strong acidity, and lack of fresh water during the growing season make much of the acreage only marginal as habitat for wildlife. Because of nearness of the areas to San Francisco and because enough vegetation can be produced for hunting use, the leasing of hunting rights has potential for good economic returns.

Wildlife Group 2

This group consists of deep alluvial soils in valleys, on flood plains, and on recent terraces. In this group are soils of the Arbuckle, Baywood, Blucher, Clear Lake, Cole, Cortina, Los Robles, Manzanita, Pajaro, Pleasanton, Tuscan, Yolo, and Zamora series. Also the miscellaneous land types Alluvial land, sandy, and Alluvial land, clayey, are in this group. The surface layer of these soils ranges from sand to clay. Many of the soils are gravelly, and some of the soils have overwash on them or are ponded. Soils in this group are poorly drained to excessively drained. Slopes range from 0 to 30 percent.

Most of the urban land and much of the cultivated land in Sonoma County are in this group. The cropland is used for orchards, vineyards, vegetables, oats and vetch hay, and pasture. Undisturbed areas have a ground cover of grasses and forbs and an overstory of some scattered oats, willows, and shrubs.

Deer are mainly on the uplands adjacent to these soils. They come into this area to feed in the orchards, vineyards, pastures, and gardens, and thus present a problem of depradation.

California quail frequent most of the soils in this group. They especially like to live near stream channels and foothills where the cover consists of shrubs and live oaks. The distribution of water generally is adequate for quail, and food for wildlife can be readily produced on these soils.

Vineyards, orchards, and urban areas provide fairly good habitat for mourning doves on these soils. These birds prefer to feed in open areas where the ground cover is not too rank.

Limited numbers of ring-necked pheasant occur where food and cover are adequate. Pheasant were common in the county when large areas were in wheat and barley. The habitat for these birds can be improved by planting patches of wheat, barley, corn, or milo for food.

Other birds found commonly on this group of soils are the white-tailed kite, robins, mockingbirds, thrushes, brown towhees, white-crowned sparrows, and cedar waxwings.

The development of shooting preserves has good potential for economic returns where they are away from urban developments and orchards. Duck ponds can be developed readily on the clay soils, such as Clear Lake, that are near the bay. The nearly level clay soils are also suitable for constructing fish ponds.

TABLE 5.--SUITABILITY OF SPECIFIED PLANTS IN SONOMA COUNTY FOR

[An Arabic number 1 means the plant named is suited to the wildlife group or has high value for the kind of dashes in the columns mean the plant is not suited to soils of the wildlife group, the suitability of the
[Food is the seed of the plant unless otherwise noted. "a" means the plant is used for cover; "b" means means forage]

Plant	Wildlife group and rating							
	1/ 1	2	3	4	5	6	7	8
Alfalfa-----------------	---	1	2	---	---	---	---	---
Alta fescue-------------	2	1	1	2	2	---	2	2
Barley------------------	2	1	1	---	---	---	---	---
Blackberry--------------	2	1	---	2	2	---	2	2
Black oak---------------	---	---	---	1	---	2	1	2
Burclover---------------	2	1	1	1	1	2	---	2
California scrub oak----	---	---	---	1	---	1	1	2
Ceanothus---------------	---	2	---	1	2	1	1	2
Chamise-----------------	---	---	---	2	---	1	2	2
Clover (annual)---------	2	1	1	1	1	1	2	2
Coffeeberry-------------	---	2	---	1	---	1	2	2
Common oats-------------	1	1	1	2	2	---	---	---
Digger pine-------------	---	---	2	1	---	1	2	2
Douglas-fir-------------	---	---	---	---	---	2	1	1
Fiddleneck--------------	2	1	1	1	1	2	2	2
Filaree-----------------	---	1	1	1	1	1	---	2
Hardinggrass------------	2	1	1	2	1	---	---	---
Live oak----------------	---	1	2	1	2	2	1	2
Lupine (annual)---------	2	1	1	1	1	1	2	2
Manzanita---------------	---	---	---	1	---	1	1	2
Mountain mahogany-------	---	---	---	2	---	1	1	2
Multiflora rose---------	2	1	2	---	---	---	---	---
Oregon white oak--------	---	1	2	1	---	2	2	2
Poison-oak--------------	---	1	2	1	2	2	1	2
Pyracantha--------------	2	1	2	---	---	---	---	---
Ryegrass----------------	1	1	1	1	1	2	1	2
Soft chess--------------	2	1	1	1	1	1	2	2
Subclover---------------	---	1	1	1	1	---	---	2
Tarweed-----------------	2	1	1	1	1	1	---	2
Toyon-------------------	2	1	---	1	2	1	2	2
Trefoil-----------------	2	1	1	2	2	---	---	2
Turkey mullein----------	2	1	1	1	1	2	---	2
Vetch-------------------	1	1	1	1	1	2	---	2
Wheat-------------------	2	1	1	---	---	---	---	---
Wild oats---------------	1	1	1	1	1	1	1	---

1/ Tidal marsh excepted.

WILDLIFE GROUPS OF SOILS AND FOR SPECIFIED KINDS OF WILDLIFE

wildlife; 2 means suitability of the plant is fair to marginal for the wildlife group or kind of wildlife; plant is not known, or the plant is seldom used by the particular kind of wildlife or its use is not known. the food is acorns; "c" means the plant is used for browse and cover; "d" means the food is fruit; and "e"

Kind of wildlife and rating								
Deer	Valley quail	Mountain quail	Band-tailed pigeon	Dove	Pheasant	Duck	Gray squirrel	Brush rabbit
1e	2e	---	---	---	2e	---	---	1e
2e	---	---	---	---	2e	---	---	2e
2e	1	---	1	2	1	1	---	2e
2c	2ad	2ad	1d	---	---	---	---	1a
1b	2b	2b	1b	---	---	2	1b	---
2e	1	2	---	---	2	---	---	1e
1bc	2ab	2ab	1b	---	---	2	2b	a
1c	2a	1a	2	---	---	---	---	2c
1c	a	a	---	---	---	---	---	2c
1e	2	2	---	---	2	1	---	1e
2c	a	a	1d	---	---	---	---	a
2e	1	---	1	2	1	2	---	2e
---	2	2	2	---	---	---	1	---
2/ 1	---	2	a	---	---	---	a	---
---	1	1	---	2	2	---	---	---
2e	1	1	---	2	2	---	---	2e
2e	2	2	---	2	2	---	---	2e
1bc	2ab	2ab	1b	---	---	2	1b	---
2e	1	2	---	2	---	---	---	---
2c	a	2da	2d	---	---	---	---	a
1c	---	a	---	---	---	---	---	a
---	a	---	---	---	1da	---	---	a
1b	2b	2b	1b	---	---	2	1b	---
1c	2da	2da	---	---	---	---	---	a
---	2da	2da	2d	---	a	---	---	a
2e	2e	2e	---	---	2e	---	---	1e
2e	2e	2e	---	---	2e	---	---	1e
1e	2e	---	---	---	2e	---	---	1e
---	2	2	---	2	2	---	---	---
1	2da	2da	2d	---	a	---	---	---
1e	2e	2	---	2	2	2	---	1e
---	1	1	---	1	---	---	---	---
2e	1	1	2	1	2	---	---	2e
2	1	1	1	1	1	1	---	1
2	2	---	---	2	2	2	---	2e

2/ Young trees only.

Wildlife Group 3

This group consists of claypan soils on old terraces around valleys, along the coast, and on some flood plains. In this group are soils of the Cotati, Haire, Huichica, Noyo, Positas, Rohnerville, and Wright series. Their surface layer ranges from coarse sandy loam to clay loam. Many of the soils are gravelly. Some of the soils are hummocky, and others are wet or are ponded. The soils are somewhat poorly drained to well drained. Slopes range from 0 to 30 percent.

Choice of plants that do well on these soils is limited by a subsoil that is moderately slowly permeable to slowly permeable. Fertility is moderately high.

Cultivated soils in this group are used for hay, irrigated and dryland pasture, grapes, prunes, and Christmas trees. Soils not cultivated generally are used for range. They support a cover of grass and forbs and have an overstory of oak and manzanita.

The soils in this group are suited to many plants, particularly forbs, that provide food for wildlife. They are capable of producing food and cover for California quail, mourning doves, other birds that eat seeds, and for deer during the winter and spring months. Cover for quail generally is adequate, particularly where 10 to 20 percent of the ground cover is brush and trees. Deer prefer the dense cover that grows on soils that have north-facing slopes. If a dense cover is lacking, trees and shrubs can be planted in swales and gullies to improve the habitat.

Wildlife Group 4

This group consists of well-drained soils on footslopes that surround the valleys. In this group are soils of the Felta, Goulding, Guenoc, Laniger, Laughlin, Sebastopol, Sobrante, Spreckles, and Supan series. The surface layer ranges from sandy loam to clay loam. Many of the soils are cobbly or gravelly, and some are eroded. Fertility is moderate to low. Elevation ranges from 500 to 3,000 feet. Slopes range from 2 to 75 percent.

On these soils the vegetative cover typically is grass and oak. The cover ranges from open grass and scattered oaks to oak woodland that has an understory of brush and grass. A few coast Douglas-firs and redwoods grow at the higher elevations. Cropland is limited largely to apple orchards and pasture.

These soils are capable of producing good food and cover for deer, California quail, and mourning doves. The habitat for deer and quail can be improved by encouraging or planting suitable trees and shrubs to provide more cover in areas where open grassland is extensive. Where mature stands of brush or of oak occur, the habitat can be improved by opening up the stands to make room for desirable forbs and grasses and for new brush sprouts and seedlings. The food supply can be increased for most kinds of wildlife by opening up the canopy and releasing the plants in the understory.

Crown sprouts on stumps of oak trees make palatable food for deer. Mountain quail, band-tailed pigeon, and gray squirrel frequent the woodland and grass habitat. Wild pigs also frequent this habitat north and west of Healdsburg, and a few wild turkeys occur southeast of Cloverdale. Many nongame birds, such as woodpeckers, jays, and towhees are also in the area.

The leasing of hunting rights to deer clubs has potential for good economic returns.

Wildlife Group 5

This group consists of soils that are scattered throughout the uplands. These soils are in the Cibo, Diablo, Dibble, Kinman, Kneeland, Kneeland sandy variant, Los Osos, Raynor, Sheridan, Steinbeck, Suther, and Yorkville series. The surface layer ranges from coarse sandy loam to clay. Many of the soils are eroded, some have a thin solum, others are seeped, and still others are rocky. Soils in this group are moderately well drained and well drained. Fertility is moderately low to moderately high. Slopes range from 2 to 75 percent.

The vegetative cover on these soils typically is grass and fairly dense stands of shrubs and trees on north-facing slopes and in swales and gullies. In places a few scattered oaks grow in the grassland. Annual and perennial grasses and a variety of weedy herbs that are important as a source of food for wildlife grow on the soils in this group.

The soils of this group provide good habitat for deer and California quail, especially where brushy draws or north-facing slopes are intermingled with areas of open grassland. Mourning doves, brush rabbits, and some birds also use this habitat. Wild turkeys frequent areas near Cloverdale, and wild pigs frequent areas near Healdsburg.

Brush can be managed to provide suitable habitat on soils that have slopes of less than 30 percent. The areas can be made more accessible and produce more food, by opening dense stands of brush on soils that have north-facing slopes or are in draws. Planting and seeding can be done on the more gently sloping, deeper soils.

Ponds can be built on the soils of this group where suitable sites for dams can be located. Ample water generally is available for wildlife. The leasing of hunting rights on these soils has good potential for economic returns.

Wildlife Group 6

This group consists of shallow to moderately deep upland soils that occur mainly in the northern and eastern parts of the county. These soils are in the Henneke, Huse, Kidd, Los Gatos, Maymen, Montara, Stonyford, and Toomes series. The surface layer ranges from sandy loam to clay loam. Many of the soils are gravelly, stony, or rocky. In most of these soils the content of gravel increases with depth. Elevation ranges from 500 to 3,500 feet.

These soils are well drained to excessively drained. Fertility is low to very low. Slopes range from 2 to 75 percent.

The vegetative cover on these soils typically is dense or semidense stands of chamise that have a sparse understory of forbs and grass. Other kinds of brush are manzanita, coffeeberry, shrub oak, poison oak, toyon, mountain mahogany, deerbrush, and buckbrush ceanothus. A few Digger pine, knobcone pine, incense-cedar, and interior live oak trees grow on these soils.

Kinds of wildlife common on soils in this group include Columbian black-tailed deer, brush rabbits, bobcats, mountain quail, California quail, band-tailed pigeon, towhees, brushtits, and other songbirds.

The habitat for deer and quail can be improved on the more gently sloping soils of this site by releasing the understory of forbs and grass in mature stands of dense brush. Also growth of new seedlings and of sprouts that are highly nutritious should be encouraged. Establishing browseways or lanes from such clearings improves access and use by wildlife. Small clearings are less likely to cause excessive erosion than large clearings, and the deer are better able to use the increased food produced. On large cleared areas, the deer population generally does not expand rapidly enough to make full use of the new food supply. As a result the brush grows back in a short time. Desirable grasses and forbs can be seeded in the clearings and the more palatable kinds of browse, such as mountain mahogany, can be encouraged.

Springs and seeps generally are adequately distributed on this site for wildlife use. The best use for soils of this site is as wildlife habitat.

Wildlife Group 7

This group consists of moderately deep to deep soils in the cooler, foggier, part of the county on uplands or on coastal terraces. They make up the largest wildlife group in the county. These soils normally produce coniferous timber. In this group are soils of the Atwell, Boomer, Caspar, Cohasset, Comptche, Empire, Forward, Goldridge, Hely, Hugo, Josephine, Mendocino, Red Hill, and Sites series. The surface layer ranges from sandy loam to clay loam. Many of the soils are eroded and many are gravelly. Some of the soils are cobbly. The soils in this group are moderately well drained and well drained. The erosion hazard is moderate to high. Fertility is low to moderately high.

Douglas-fir and redwood are the main kinds of timber, but sugar pine, ponderosa pine, bishop pine, and knobcone pine grow in places in the county. California black oak is common in the Douglas-fir and pine forest cover, and madrone, tan oak, and Oregon white oak occur in other stands. Blueblossom ceanothus, salal, coast rhododendron, manzanita, wavyleaf ceanothus, and brachen fern are understory plants that grow in the cooler coastal areas. Deerbrush ceanothus, manzanita, and poison oak are common shrubs where the climate is warmer.

Columbian black-tailed deer, gray squirrel, band-tailed pigeon, mountain quail, and brush rabbits are the main kinds of game that live in areas of these soils. Other kinds of wildlife are woodpeckers, nuthatches, thrushes, and other birds.

Pure stands of mature timber provide limited habitat for most wildlife, and for game species in particular. Fair to good habitat is provided in openings or regrowth areas. As the canopy closes, the understory plants that produce most of the food supply are shaded out. Harvesting the mature timber, thinning, and pruning young stands, improve the habitat by opening the canopy. Encouraging or planting choice food plants in such openings increases their value for wildlife.

In spring deer browse young redwood and, in particular, Douglas-fir. They eat the terminal buds and do considerable damage to seedlings where other choice foods are not available. If extensive tree plantings are made, the number of deer in the area need to be controlled until the young trees are tall enough to escape the reach of the deer. Gray squirrels also damage redwood trees by girdling them near the crown. If choice squirrel foods are scarce and the squirrel population is high, the squirrels become a concern to management.

Wildlife Group 8

Areas of this group are scattered throughout the county. In this group are the land types Coastal beaches, Dune land, Gullied land, Riverwash, Rock land, and Terrace escarpments.

Coastal beaches provide some habitat for such shore birds as sea gulls, sandpipers, and plovers. They also provide habitat for harlequin ducks, black brant, and other waterfowl along the shore. The main use of the Coastal beaches, however, is for recreation, such as fishing.

Dune land is also used for recreation. Sea gulls and other birds rest, at times, on the dunes. Stabilizing the dunes with grass, trees, and shrubs provides habitat for brush rabbits, deer, and songbirds.

Areas of Gullied land that have been stabilized by plantings of grass, forbs, and woody vegetation provide habitat for deer, quail, rabbits, and songbirds.

Ponds and reservoirs provide habitat for ducks and fish. Most ducks, dabblers in particular, that migrate or winter along the ocean or on the bay seek out fresh water if it is available. Farm ponds near the coast therefore have a special attraction for ducks. They can be made even more attractive if choice food plants are available. Sego pondweed, arrowhead, watergrass, and saltmarsh bulrush are choice foods for ducks.

The ponds in the cooler areas of the county where the water temperature stays at no more than 70° F. in summer are suited to trout. Black bass, bluegill, redeared sunfish, and channel catfish live in streams in the inland valleys where the climate is warmer and the water temperature is more than 70°.

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Production of fish in a pond depends upon its fertility, which, in turn, depends upon the fertility of the soil in the watershed above the pond and to some extent upon the soil that forms the pond bottom. Ponds constructed in infertile soils produce less fish per acre than ponds constructed in fertile soils. Adding chemical fertilizers increases fertility, but this is not advisable near the coast where summer fogs occur. The fog shuts out light, and without sunlight the microscopic plants or plankton do not give off oxygen. As a result, heavy plankton "blooms" form and cause fish to die after several days of dense fog.

Ponds and reservoirs in this area have good potential for economic returns from hunting waterfowl and from production of fish.

Areas of Riverwash that are covered by water in winter are suitable for salmon and steelhead spawning beds if silting from excessive erosion does not occur. Water temperatures of 65° and lower are needed for successful spawning of these fish. The Russian River, its tributaries, and other coastal streams provide spawning and rearing habitat for steelhead and rainbow trout and for silver salmon. Chinook salmon are being introduced into the Russian River. Striped bass and American shad also spawn in the Russian River.

Racoons, mink, and such songbirds as thrushes, mockingbirds, and dippers obtain food from the vegetation along the river and the smaller streams.

Rock land, Terrace escarpments, and rocky steep slopes along the Pacific coast provide some habitat for eagles, hawks, and other kinds of wildlife. This use is only incidental to use of the surrounding habitat. Little can be done to improve this habitat for wildlife.

Engineering Uses of the Soils

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, and pipelines, the foundations of buildings, facilities for storing water, structures for controlling erosion, drainage systems, and systems for disposing of sewage. The properties most important to the engineer are permeability, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, available water holding capacity, particle size, plasticity, and reaction. Also important are depth to water table, depth to bedrock, and relief. Such information is made available in this section. Engineers can use this information to--

1. Make soil and land use studies that will aid in selecting and developing sites for industries, businesses, residences, and recreational areas.
2. Make preliminary estimates of the engineering properties of soils in the planning of agricultural drainage systems, irrigation systems, farm ponds, land leveling, and diversion terraces.
3. Make preliminary evaluations of soil conditions that will aid in selecting locations for highways, pipelines, and cables, and in planning more detailed investigations for the selected locations.
4. Locate probable sources of sand, gravel, and other materials suitable for construction needs.
5. Supplement information from other published maps, reports, and aerial photographs.
6. Determine the suitability of the soils for cross-country movement of vehicles and construction equipment.
7. Correlate performance of engineering structures with mapping units to develop information for general planning that will be useful in designing and maintaining the structures.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

It should be emphasized that the interpretations made in this soil survey do not eliminate the need for sampling and testing needed at a site chosen for a specific engineering work that involves heavy loads or at a site where excavations are to be deeper than the depths of the layers here reported. Nevertheless, by using this survey, an engineer can select and concentrate on those kinds of units most important for his proposed kind of construction, and in this manner, reduce the number of samples taken for laboratory testing and complete an adequate soil investigation at minimum cost.

The soil mapping units shown on the maps in this survey may include small areas of a different soil material. These included soils are too small to be mapped separately and generally are not significant to the agriculture in the area but may be important in engineering planning.

Information of value in planning engineering work is given throughout the text, particularly in the sections "Descriptions of the Soils" and "Formation, Classification, and Morphology of Soils"

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words--for example, soil, clay, silt, and sand--may have a special meaning in soil science. These and other special terms used in the soil survey are defined in the Glossary at the back of this survey. Most of the information about engineering is given in tables 6, 7, and 8.

Engineering Classification Systems

Most highway engineers classify soil material according to the system approved by the American Association of State Highway Officials (AASHO) (1). In this system soil materials are placed in seven principal groups based on field performance. The groups range from A-1, consisting of gravelly and coarse sandy soils of high bearing capacity, to A-7, consisting of clayey soils having low strength when wet.

Some engineers prefer to use the Unified soil classification system developed by the U.S. Army Corps of Engineers and adopted by the U.S. Department of Defense (29). This system is based on the texture and plasticity of soils and the performance of soils as material for engineering works. In this system soil materials are classified as coarse grained (eight classes), fine grained (six classes), or highly organic (one class). An approximate classification can be made in the field. Table 8 shows the classification of the tested soils according to the AASHO and Unified systems.

Estimated Engineering Properties

Table 6 lists the soil series in Sonoma County, lists the map symbols for each mapping unit, and gives estimates of soil properties significant to some engineering work.

Given in table 6 are the depth to bedrock, depth to seasonal high water table, and depth from surface in a typical profile. In addition the estimated USDA, Unified, and AASHO classifications, and the percentages of material passing the various sieves are given. Also shown are estimates of Atterberg values, permeability, available water capacity, reaction, shrink-swell potential, and corrosivity of uncoated steel. The estimates are based partly on examinations made in the field and partly on results of test data shown in table 8. Since the estimates are only for typical soils, considerable variation from these values should be

TABLE 6.--ESTIMATED ENGINEERING

The land types Alluvial land, sandy (AdA); Alluvial land, clayey (AeA); Coastal beaches (ChA); Dune land are so variable that their

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two this reason, it is necessary to follow carefully the instructions for referring to other series that

Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	More than 3 inches
	Feet	Feet	Inches				Percent
Arbuckle: AgB, AgD, AgE, AkB, AkC.	>5	(2/)	0-27	Gravelly sandy loam and loam.	ML or SC	A-4	-----
			27-72	Gravelly clay loam.	CL	A-6	0-10
Atwell: AtF, AtG-----	>5	(2/)	0-28	Clay loam--------	CL or ML	A-6 or A-7	-----
			28-64	Silty clay and clay.	CH or MH	A-7	-----
Baywood: BaC, BaE----	>5	(2/)	0-56	Loamy sand and sand.	SM	A-2	-----
Blucher: BcA, BhA, BhB, BlA, BlB.	>5	3½-5	0-34	Fine sandy loam, loam, and silt loam.	SM or CL	A-4 or A-6	-----
			34-72	Silty clay loam and silt loam.	ML or CL	A-7	-----
Boomer: BoE, BoF, BoG.	2½-5	(2/)	0-19	Loam------------	ML or CL	A-4 or A-6	-----
			19-55	Gravelly clay loam and clay loam.	CL	A-6	0-5
			55	Basic igneous rock.			
Caspar: CaE, CaF-----	4-5	(2/)	0-12	Sandy loam-------	SM	A-2 or A-4	-----
			12-60	Clay loam and sandy clay loam.	CL or ML	A-6 or A-7	-----
Cibo: CbF------------	2½-4½	>5	0-48	Clay-------------	CH or MH	A-7	0-10
Clear Lake: CcA, CcB, CeA, CeB, CfA.	>5	3-5	0-60	Clay (clay loam surface layer in some areas).	CH	A-7	-----
			60-72	Sandy clay loam--	SC	A-4	-----
Clough: CgC, CgD, CgE.	1-3	(2/)	0-10	Gravelly loam----	SM	A-4	0-10
			10-23	Very gravelly clay loam and very gravelly clay.	GC	A-2	5-15
			23	Indurated hardpan.	-----	-----	-----

See footnotes at end of table.

PROPERTIES OF THE SOILS

(DuE); Gullied land (GuF); Riverwash (RnA); Rock land (RoG); Terrace escarpments (TeG); and Tidal marsh (TmA) properties have not been estimated.
or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for appear in the first column of this table. The symbol > means more than; < means less than.]

Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Atterberg values -- Liquid limit	Plastic index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
						Inches per hour	Inches per inch of soil	pH value		
70-90	65-85	50-60	40-60	10-25	0-10	0.63-2.0	0.12-0.14	6.1-7.3	Low---------	Low.
70-90	65-85	60-70	50-60	20-40	10-30	0.2-0.63	0.14-0.16	5.6-6.5	Low to moderate.	Moderate.
90-100	85-100	80-100	70-80	30-50	10-30	0.2-0.63	0.19-0.21	4.5-5.5	Moderate---	High.
90-100	85-100	80-100	75-95	50-60	20-40	<0.06	0.08-0.10	5.6-7.3	High-------	High.
100	100	50-75	15-30	-----	1/ NP	6.3-20.0	0.06-0.08	5.6-6.5	Low---------	Low.
100	100	70-85	40-70	20-40	0-35	0.63-2.0	0.14-0.18	5.6-8.4	Low to moderate.	Moderate to high.
100	100	95-100	85-95	40-50	10-30	0.06-0.2	0.19-0.21	7.4-8.4	High-------	High.
100	100	85-95	60-75	30-40	5-15	0.63-2.0	0.16-0.18	6.1-6.5	Moderate---	Low.
75-85	70-80	55-65	50-60	30-40	10-20	0.63-2.0	0.16-0.18	5.6-6.5	Moderate---	Moderate.
100	100	60-70	30-40	10-30	0-10	2.0-6.3	0.11-0.13	4.5-5.5	Low---------	Moderate.
100	100	90-100	70-80	30-45	10-30	0.63-2.0	0.17-0.19	4.5-5.5	Low---------	High.
85-100	80-100	75-100	70-90	50-65	20-35	0.06-0.2	0.13-0.16	6.1-7.3	High-------	High.
100	100	95-100	80-95	50-60	20-35	0.06-0.2	0.14-0.16	5.1-8.4	High-------	High.
90-100	85-100	75-90	35-50	15-25	5-10	0.06-0.2	0.14-0.16	7.4-8.4	Moderate---	High.
70-80	65-75	50-60	35-45	10-35	0-10	0.63-2.0	0.12-0.14	5.1-5.5	Low---------	Moderate.
40-55	35-50	25-40	20-35	20-40	10-30	0.06-0.2	0.10-0.12	4.5-5.0	Moderate---	Moderate.
------	------	-----	-----	------	-----	<0.06	---------	4.5-5.0	----------	----------

Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	More than 3 inches
	Feet	Feet	Inches				Percent
Cohasset: CmE, CmF, CmG.	1½-5	(2/)	0-19	Gravelly loam----	SM or ML	A-4	0-10
			19-29	Gravelly clay loam.	SC or CL	A-6	0-10
			29	Weathered volcanic rocks.			
Cole: CnA, CnB, CoA, CoB.	>5	1-4	0-45	Silt loam, silty clay loam, and clay loam.	CL	A-6	-----
			45-66	Clay-------------	CH	A-7	-----
Comptche: CpG--------	2½-4	(2/)	0-38	Gravelly clay loam.	CL	A-6	5-15
			38-48	Gravelly clay----	CL	A-7	5-15
			48	Weathered greenstone.			
Cortina: CrA, CsA----	>5	(2/)	0-60	Very gravelly sandy loam.	GM-GW	A-1	5-15
Cotati: CtC, CtD, CtE.	>5	(2/)	0-22	Fine sandy loam and sandy loam.	SM	A-4	-----
			22-68	Clay-------------	CH	A-7	-----
Diablo: DbC, DbD, DbE, DbE2, DbF, DbF2.	2-5	(2/)	0-72	Clay-------------	CH or MH	A-7	-----
Dibble: DcC, DcD, DcE, DcE2, DcF, DcF2.	2½-5	(2/)	0-16	Clay loam--------	CL	A-6	-----
			16-60	Clay-------------	CL	A-6 or A-7	-----
			60	Sandstone and siltstone.			
*Empire: EmE, EmF, EpF. For properties of Caspar soils in unit EpF, refer to Caspar series in this table.	2½-5	(2/)	0-19	Loam-------------	ML or CL	A-4	-----
			19-60	Silty clay loam--	CL	A-6	-----
Felta: FaD, FaE, FaF, FaG.	>5	(2/)	0-60	Very gravelly clay loam and very gravelly sandy clay loam.	GC	A-2	10-20

See footnotes at end of table.

Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Atterberg values: Liquid limit	Plastic index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
						Inches per hour	Inches per inch of soil	pH value		
60-95 60-95	55-95 55-95	50-65 50-90	35-60 40-70	10-35 20-40	0-10 10-30	0.63-2.0 0.63-2.0	0.14-0.16 0.16-0.18	5.6-6.5 5.1-5.5	Low--------- Moderate---	Moderate. Moderate.
100	100	95-100	85-95	20-40	10-30	0.2-0.63	0.19-0.21	6.1-7.3	Moderate---	High.
100	100	90-100	75-95	50-60	20-40	0.06-0.20	0.14-0.16	7.4-7.9	High-------	High.
70-80	65-75	60-70	50-60	20-40	10-30	0.63-2.0	0.15-0.17	5.1-6.0	Low---------	Moderate.
70-80	65-75	60-70	50-60	40-50	20-30	0.2-0.63	0.12-0.14	5.1-5.5	Moderate---	High.
15-55	10-50	5-30	5-10	(1/)	(1/)	>20.0	0.03-0.05	5.6-7.3	Low---------	Low.
100	100	70-85	40-50	10-35	0-10	2.0-6.3	0.13-0.15	5.1-5.5	Low---------	Moderate.
100	100	90-100	85-95	50-65	35-50	0.06-0.2	0.04-0.06	4.0-5.0	High-------	High.
100	100	95-100	90-100	50-65	20-35	0.06-0.2	0.14-0.16	6.1-8.4	High-------	High.
100 100	100 100	90-100 95-100	70-80 85-95	20-35 35-45	10-25 15-25	0.2-0.63 0.06-0.2	0.19-0.21 0.14-0.16	5.6-6.0 5.1-7.3	Moderate--- High-------	Moderate. High.
100 100	100 100	85-95 95-100	60-75 85-95	10-20 25-40	0-10 15-30	0.63-2.0 0.2-0.63	0.16-0.18 0.19-0.21	5.1-6.5 4.5-5.5	Low--------- Low---------	Moderate. High.
15-45	10-35	10-30	5-20	20-35	15-30	0.63-2.0	0.09-0.11	5.1-6.5	Low---------	Low.

Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	More than 3 inches
	Feet	Feet	Inches				Percent
*Forward: FoE, FoG, FrG. For properties of Kidd soils in unit FrG, refer to Kidd series in this table.	1½-3½	(2/)	0-21 21	Gravelly sandy clay loam. Rhyolite.	SM or SC	A-2	0-20
Goldridge: GdC, GdD, GdD2, GdE, GdE2, GdF, GdF2.	3½-5	(2/)	0-28 28-72	Fine sandy loam-- Sandy clay loam--	SM ML or CL	A-4 A-4 or A-6	----- -----
Goulding: GgD, GgE, GgF, GgF2, GgG, GoF. For properties of Toomes soils in unit GoF, refer to Toomes series in this table.	1-2	(2/)	0-11 11-22 22	Clay loam-------- Very gravelly clay loam. Fractured rock.	CL GC	A-6 A-2	----- 0-20
Goulding: GlD, GlE, GlF, GlF2, GlG.	1-2	(2/)	0-10 10-20 22	Cobbly clay loam- Very gravelly clay loam. Fractured rock.	CL GC	A-6 A-2	15-40 0-20
Guenoc: GrE, GrG-----	1½-3½	(2/)	0-38 38	Clay loam and clay. Basalt.	CL	A-6	-----
Haire: HbC, HbD, HbD2, HbE.	>5	(2/)	0-24 24-36 36-60	Gravelly loam---- Gravelly clay---- Very gravelly and cobbly clay loam.	SM or SC CH GC	A-4 A-7 A-2	----- ----- 10-20
Haire: HaB, HcC, HcD, HcD2, HcE, HcE2.	>5	(2/)	0-24 24-36 36-60	Clay loam (fine sandy loam surface layer in places). Clay------------- Very gravelly and cobbly clay loam.	CL CH GC	A-6 A-7 A-2	----- ----- 10-20
Hely: HeF, HeG-------	1½-4	(2/)	0-29 29	Silt loam-------- Sandstone and shale.	ML	A-4	-----

See footnotes at end of table.

Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Atterberg values Liquid limit	Plastic index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
						Inches per hour	Inches per inch of soil	pH value		
65-75	60-70	45-60	25-35	15-25	10-20	0.63-2.0	0.10-0.12	4.5-7.3	Low--------	Low.
100	100	90-100	35-50	(1/)	(1/)	0.63-2.0	0.13-0.15	4.5-6.5	Low--------	Low.
100	100	90-100	50-60	25-35	5-15	0.2-0.63	0.14-0.16	4.5-5.5	Moderate---	Moderate.
90-100	85-95	75-85	60-70	30-40	15-30	0.63-2.0	0.19-0.21	5.6-6.5	Moderate---	Moderate.
40-50	35-45	30-40	20-30	30-40	15-30	0.63-2.0	0.09-0.11	6.1-6.5	Low--------	Low.
90-95	85-95	75-85	60-70	30-40	15-30	0.63-2.0	0.15-0.17	5.6-6.5	Moderate---	Moderate.
40-50	35-45	30-40	20-30	30-40	15-30	0.63-2.0	0.09-0.11	6.1-6.5	Low--------	Low.
95-100	90-100	85-95	65-75	25-40	10-25	0.2-0.63	0.18-0.20	5.6-7.3	Moderate---	Moderate.
65-80	60-75	50-65	35-50	20-30	5-10	0.63-2.0	0.12-0.14	6.1-7.3	Low--------	Moderate.
65-80	60-75	50-70	50-60	50-60	30-40	0.06-0.2	0.04-0.06	5.1-5.5	High-------	High.
45-55	40-50	35-45	25-35	30-40	10-20	0.06-0.2	0.07-0.09	5.1-5.5	Low--------	Moderate.
100	100	90-100	70-80	30-40	20-30	0.2-0.63	0.19-0.21	6.1-7.3	Moderate---	Moderate.
100	100	90-100	75-95	50-60	30-40	0.06-0.2	0.04-0.06	5.1-5.5	High-------	High.
45-55	40-50	35-45	25-35	30-40	10-20	0.06-0.2	0.07-0.09	5.1-5.5	Low--------	Moderate.
100	100	90-100	70-90	20-35	0-10	0.63-2.0	0.19-0.21	5.1-6.0	Moderate---	Moderate.

Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	More than 3 inches
	Feet	Feet	Inches				Percent
Henneke: HgE, HgG2---	1-1½	(2/)	0-16	Gravelly loam and very gravelly clay.	GC	A-2	5-15
			16	Serpentine.			
*Hugo: HhF, HnE, HnG, HnG2. For properties of Josephine soils in mapping units HnE, HnG, and HnG2, refer to Josephine series in this table.	2½-5	(2/)	0-48	Loam and sandy clay loam.	CL	A-6	-----
			48	Sandstone.			
*Hugo: HkF, HkG, HkG2, HlF, HlG, HmF, HmG, HoG, HsF, HrG, HsG. For properties of the Atwell soils in units HlF and HlG, the Boomer soils in units HmF and HmG, the Laughlin soil in Unit HoG, the Los Gatos soil in unit HrG, and the Hely soils in units HsF and HsG, see their respective series in this table.	2½-5	(2/)	0-48	Gravelly loam and gravelly sandy clay loam.	SC	A-4 or A-6	0-5
			48	Sandstone.			
Huichica: HtA, HtC, HtD, HuB, HvC, HwB.	2-3½	(2/) (1-2 in HuB and HwB)	0-23	Loam and sandy clay loam.	ML or CL	A-4 or A-6	-----
			23-30	Clay------------	CL	A-7	-----
			30-60	Strongly cemented hardpan.			
Huse: HyG------------	1-2	(2/)	0-22	Stony clay loam, silty clay loam, and gravelly silty clay loam.	CL	A-6	5-15
			22	Serpentine.			

See footnotes at end of table.

Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Atterberg values Liquid limit	Plastic index	Permea-bility	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
						Inches per hour	Inches per inch of soil	pH value		
40-65	35-60	30-50	20-35	30-40	10-30	0.2-0.63	0.10-0.12	6.6-8.4	Low--------	Low.
100	100	85-95	50-65	15-30	10-20	0.63-2.0	0.16-0.18	5.1-7.3	Moderate---	Moderate.
55-70	50-65	45-55	35-50	15-30	10-20	0.63-2.0	0.12-0.14	5.1-7.3	Moderate---	Moderate.
90-100	85-100	80-95	60-75	20-35	5-15	0.63-2.0	0.16-0.18	5.1-5.5	Moderate---	Moderate to high.
90-100	85-100	80-100	75-95	40-50	15-30	<0.06 <0.06	0.04-0.06 ---------	5.6-6.0 7.4-8.4	High-------	High.
65-95	60-90	55-85	50-60	30-40	20-30	0.63-2.0	0.16-0.18	6.1-7.3	Moderate---	Moderate.

Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	More than 3 inches
	Feet	Feet	Inches				Percent
*Josephine: JoE, JoF, JoF2, JoG, JsG. For properties of Sites soils in unit JsG, refer to Sites series in this table.	2-5+	(2/)	0-13	Loam-------------	CL or ML	A-4 or A-6	0-5
			13-25	Clay loam--------	CL	A-6	0-5
			25-36	Fine sandy loam--	SM	A-4	0-5
			36	Sandstone.			
Kidd: KdF, KeE, KkG--	½-1½	(2/)	0-15	Gravelly loam (stony in places).	SC or SM	A-4 or A-6	0-20
			15	Rhyolitic rock and tuff.			
*Kinman: KlD, KlE, KlF, KmF. For properties of Kneeland soils in unit KmF, refer to Kneeland series in this table.	2½-5+	(2/)	0-12	Loam and clay loam.	CL	A-6	-----
			12-54	Clay-------------	CH	A-7	-----
			54	Sandstone.			
Kneeland: KnC, KnD, KnE, KnF, KoG.	2-4	(2/)	0-13	Loam-------------	CL	A-6	-----
			13-35	Clay loam--------	CL	A-6	-----
			35	Sandstone.			
Kneeland, sandy variant: KsD, KsE, KvE.	1-3	(2/)	0-18	Sandy loam-------	SM	A-2	-----
			18-28	Loamy coarse sand.	SM	A-2	-----
			28	Weathered sandstone.			
Laniger: LaC, LaD, LaE, LaE2, LaF.	1½-4	(2/)	0-29	Loam-------------	ML or CL	A-6	-----
			29	Fractured rhyolite.			
*Laughlin: LgE, LgF, LgG, LgG2, LhG. For properties of Yorkville soils in mapping unit LhG, refer to Yorkville series in this table.	1-3	(2/)	0-22	Loam and sandy clay loam.	SC	A-6	-----
			22	Sandstone and shale.			

See footnotes at end of table.

Percentage passing sieve--				Atterberg values		Permea-bility	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Liquid limit	Plastic index					
						Inches per hour	Inches per inch of soil	pH value		
70-100	65-100	60-95	55-70	20-30	5-15	0.63-2.0	0.14-0.18	5.6-6.0	Moderate---	Moderate.
70-100	65-100	60-90	60-75	30-40	15-30	0.63-2.0	0.17-0.21	5.6-6.5	Moderate---	Moderate.
70-100	65-100	60-85	35-50	10-25	0-5	2.0-6.3	0.12-0.15	5.6-6.0	Low---------	Low.
60-80	50-70	45-65	35-50	20-30	5-15	6.3-20.0	0.12-0.14	5.6-6.5	Low---------	Low.
100	100	85-95	65-80	30-40	15-30	0.63-2.0	0.19-0.21	5.1-6.5	Moderate---	Moderate.
100	100	90-100	75-95	50-60	30-40	0.06-0.2	0.14-0.16	5.1-7.3	High--------	High.
100	100	85-95	60-75	20-30	15-20	0.63-2.0	0.16-0.18	5.1-6.0	Moderate---	Moderate.
100	100	90-100	70-80	30-40	20-30	0.63-2.0	0.19-0.21	5.1-6.0	Moderate---	Moderate.
100	100	60-70	20-35	(1/)	(1/)	2.0-6.3	0.11-0.13	5.1-6.0	Low---------	Low.
100	95-100	40-55	10-20	(1/)	(1/)	2.0-6.3	0.06-0.08	4.5-5.0	Low---------	Low.
100	100	85-95	60-75	30-40	10-20	0.63-2.0	0.16-0.18	5.1-6.0	Moderate---	Moderate.
80-100	70-100	60-90	35-50	20-30	10-20	0.63-2.0	0.14-0.16	5.1-6.0	Moderate---	Moderate.

Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	More than 3 inches
	Feet	Feet	Inches				Percent
*Los Gatos: LkG, LmG, LnG. For properties of Josephine soils in mapping unit LnG, refer to Josephine series in this table.	2-4	(2/)	0-17	Loam or gravelly loam.	SM or SC	A-4 or A-6	------
			17-25	Gravelly clay loam.	SC or SM	A-4 or A-6	------
			25	Sandstone and shale.			
Los Osos: LoD, LoE, LoF, LoF2, LsD, LsE, LsE2, LsF2.	1½-4	(2/)	0-16	Clay loam---------	CL or ML	A-6 or A-7	------
			16-34	Clay--------------	CL or ML	A-6 or A-7	------
			34	Sandstone.			
Los Robles: LuA, LvB--	>5	(2/)	0-60	Gravelly clay loam.	SC	A-6	0-5
			60-72	Very gravelly sandy clay.	GC	A-2	0-15
Manzanita: MbC--------	>5	(2/)	0-66	Clay loam---------	CL	A-6	------
*Maymen: McF, MlG---- For properties of Los Gatos soil in mapping unit MlG, refer to Los Gatos series in this table.	1-1½	(2/)	0-18	Gravelly sandy loam and gravelly loam.	SM	A-2	0-10
			18	Sandstone and shale.			
Mendocino: MmE, MmF, MnF. For properties of Empire soils in mapping unit MnF, refer to Empire series in this table.	2½-5	(2/)	0-26	Sandy clay loam---	SC	A-6	------
			26-54	Sandy clay--------	CL	A-6	------
			54	Soft sandstone and shale.			
Montara: MoE, MoG-----	½-1½	(2/)	0-9	Cobbly clay loam.	CL	A-4 or A-6	15-25
			9	Serpentine.			
Noyo: NoD------------	>5	(2/)	0-29	Coarse sandy loam and sandy loam.	SM	A-2	------
			29-53	Sandy clay loam---	CL	A-7	------
			53-60	Loamy sand--------	SM	A-2	------

See footnotes at end of table.

Percentage passing sieve--				Atterberg values		Permea-bility	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Liquid limit	Plastic index					
						Inches per hour	Inches per inch of soil	pH value		
80-100	65-95	50-60	35-50	20-40	5-15	0.63-2.0	0.14-0.18	6.1-7.3	Low to moderate.	Low.
85-95	65-70	50-65	40-50	20-30	5-15	0.2-0.63	0.15-0.19	5.6-6.5	Moderate---	Moderate.
100	100	90-100	85-95	35-45	10-20	0.2-0.63	0.19-0.21	5.6-6.0	Moderate---	Moderate.
100	100	90-100	85-100	35-50	10-25	0.06-0.2	0.14-0.16	6.6-7.3	High-------	High.
55-85	50-80	45-60	35-50	30-40	15-30	0.2-0.63	0.14-0.16	6.6-7.3	Moderate---	Moderate.
10-20	10-20	5-15	5-10	40-50	15-25	0.2-0.63	0.06-0.08	6.1-6.5	Low--------	Moderate.
70-95	65-95	60-90	50-75	30-40	15-25	0.2-0.63	0.17-0.21	5.6-6.0	High-------	High.
70-90	65-85	45-60	25-35	(1/)	(1/)	0.63-2.0	0.09-0.11	5.1-6.0	Low--------	Low.
100	100	80-90	35-50	20-30	10-20	0.63-2.0	0.14-0.16	5.6-6.5	Low--------	High.
100	100	85-95	50-60	30-40	20-30	0.2-0.63	0.15-0.17	5.1-5.5	Moderate---	High.
80-90	75-85	70-80	60-70	30-40	15-25	0.2-0.63	0.15-0.17	6.6-8.4	Low--------	Moderate.
100	100	60-70	25-35	(1/)	(1/)	2.0-6.3	0.10-0.12	4.0-5.5	Low--------	Moderate.
100	100	90-100	75-85	40-50	25-35	0.06-0.2	0.04-0.06	4.0-5.5	Low--------	High.
100	100	50-75	15-25	(1/)	(1/)	2.0-6.3	0.06-0.08	4.0-5.5	Low--------	Moderate.

Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	More than 3 inches
	Feet	Feet	Inches				Percent
Pajaro: PaA, PaB, PbB, PcA, PcB.	>5	3-5	0-72	Fine sandy loam (Gravelly loam or clay loam surface layer in places).	SM	A-4	------
*Pleasanton: PeA, PeC, PhB, PgB, PkC, PlC, PlD. For properties of Haire soil in unit PlD, refer to Haire series in this table.	>5	(2/)	0-46	Gravelly loam (loam, clay loam, or gravelly clay loam surface layer in places).	ML or SM	A-4 or A-6	0-5
			46-72	Gravelly clay loam and gravelly sandy clay loam.	SC or CL	A-6	0-10
Positas: PsC, PsD-----	>5	(2/)	0-22	Gravelly loam and clay loam.	CL or ML	A-4 or A-6	------
			22-47	Clay-------------	CH or MH	A-7	------
			47-60	Gravelly clay----	CH or MH	A-7	------
*Raynor: RaC, RaD, RaE, RcD, ReE. For properties of Montara soils in unit ReE, refer to Montara series in this table.	1½-5	(2/)	0-47	Clay-------------	CH	A-7	------
			47-56	Very cobbly and stony clay.	CH	A-7	40-60
			56	Basaltic cobbles and stones.			
Red Hill: RhD, RhE, RhF, R1G.	2½-5	(2/)	0-50	Clay loam--------	CL	A-6	20-35 in unit R1G only
			50-72	Clay-------------	CL	A-7	------
Reyes: RmA------------	>5	0-4	0-63	Silty clay stratified with muck and organic material.	MH, OH	A-7 or A-8	------
Rohnerville: RrC, RrD.	>5	(2/)	0-16	Loam and silt loam.	ML or CL	A-6	------
			16-60	Sandy clay loam and sandy clay.	SC or CL	A-6	------
Sebastopol: SbC, SbD, SbD2, SbE.	>5	(2/)	0-8	Sandy loam-------	SM	A-2	------
			8-18	Clay loam--------	CL	A-6	------
			18-62	Clay and heavy clay loam.	CL	A-7	------

See footnotes at end of table.

Percentage passing sieve-- No. 4 (4.7 mm.)	No. 40 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Atterberg values Liquid limit	Plastic index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
						Inches per hour	Inches per inch of soil	pH value		
70-100	65-100	55-85	35-50	10-20	0-5	0.2-0.63	0.13-0.15	5.6-8.4	Low-------	Moderate.
70-95	65-90	60-70	40-60	20-30	5-15	0.63-2.0	0.12-0.14	4.5-6.0	Low-------	Low.
60-75	55-70	50-65	45-60	30-40	10-20	0.2-0.63	0.15-0.17	5.6-6.0	Moderate--	Moderate.
75-95	70-90	60-85	50-70	20-35	0-15	0.2-0.63	0.17-0.19	5.1-6.0	Moderate--	Moderate.
100	95-100	85-95	80-90	50-60	20-30	<0.06	0.04-0.06	6.1-7.3	High------	High.
70-85	65-80	55-75	50-65	50-60	20-30	0.06-0.2	0.12-0.14	6.6-7.3	Moderate--	High.
100	100	90-100	75-95	60-70	30-40	0.06-0.2	0.14-0.16	6.1-8.4	High------	High.
75-95	70-90	60-80	50-70	60-70	30-40	0.06-0.2	0.06-0.08	7.9-8.4	Moderate--	High.
100	100	90-100	70-80	30-40	20-30	0.63-2.0	0.19-0.21	5.6-6.5	Moderate--	Moderate.
100	100	90-100	75-95	40-50	25-35	0.2-0.63	0.14-0.16	5.6-6.0	High------	High.
100	90-100	85-100	80-95	60-70	10-30	0.06-0.2	0.14-0.16	4.0-4.5	High------	High.
100	100	85-95	60-75	30-40	10-20	0.63-2.0	0.16-0.18	5.1-6.0	Moderate--	Moderate.
100	100	80-90	35-60	30-40	10-30	0.2-0.63	0.14-0.16	5.6-6.0	Moderate--	Moderate to high.
85-100	80-100	55-70	25-35	(1/)	(1/)	0.63-2.0	0.11-0.13	4.5-6.0	Low-------	Low.
85-100	80-100	80-90	60-75	30-40	20-30	0.2-0.63	0.19-0.21	4.0-5.0	Low-------	High.
85-100	80-100	80-95	75-90	40-50	23-35	0.2-0.63	0.14-0.16	4.0-4.5	Moderate--	High.

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Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	More than 3 inches
	Feet	Feet	Inches				Percent
Sheridan: SeE--------	3-5	(2/)	0-47	Coarse sandy loam.	SM	A-2	------
			47	Granodiorite.			
Sites: SfE, SfF------	3-5	(2/)	0-9	Loam and clay loam.	CL or ML	A-4 or A-6	------
			9-55	Clay and clay loam.	CL or ML	A-6 or A-7	------
			55	Weathered sandstone.			
Sobrante: ShE, ShF, ShG.	1½-3½	(2/)	0-20	Loam and clay loam.	CL	A-6	------
			20	Weathered greenstone.			
Spreckels: SkC, SkD, SkE, SkE2, SkF.	2-5	(2/)	0-18	Loam and clay loam.	CL or ML	A-6	------
			18-37	Clay------------	CL	A-7	------
			37	Cemented tuff and very gravelly clay loam.			
Steinbeck: SnC, SnD, SnD2, SnE, SnE2, SnF, SnF2.	1½-5+	(2/)	0-35	Loam and fine sandy loam.	CL	A-6	------
			35-56	Clay loam-------	CL	A-6	------
			56	Sandstone.			
*Stonyford: SoF, SoG, SrG. For properties of Boomer soils in unit SrG, refer to Boomer series in this table.	1-2	(2/)	0-5	Gravelly loam---	SC	A-6	0-10
			5-19	Gravelly clay loam and very gravelly clay loam.	GC	A-4	5-20
			19	Greenstone.			
Supan: SsG-----------	2½-4½	(2/)	0-39	Silty clay loam and clay loam.	CL	A-6	------
			39	Basic igneous rock.			
*Suther: StE, StE2, StF, SuF, SuG. For properties of Laughlin soils in units SuF and SuG, refer to Laughlin series in this table.	1½-3½	(2/)	0-14	Clay loam-------	CL	A-6	------
			14-36	Gravelly clay---	CL	A-7	0-10
			36	Sandstone.			

See footnotes at end of table.

Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Atterberg values Liquid limit	Plastic index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
						Inches per hour	Inches per inch of soil	pH value		
95-100	90-100	50-60	25-35	(1/)	(1/)	2.0-6.3	0.10-0.12	5.6-6.0	Low-------	Low.
90-100	75-100	70-85	55-65	20-35	0-15	0.63-2.0	0.19-0.21	5.6-6.0	Low-------	Moderate.
90-100	80-100	80-90	70-85	35-50	20-30	0.2-0.63	0.14-0.16	4.5-5.5	Moderate--	High.
95-100	90-100	85-100	65-75	30-40	15-25	0.63-2.0	0.19-0.21	6.1-6.5	Moderate--	Moderate.
75-100	70-100	65-95	50-75	30-40	10-25	0.2-0.63	0.17-0.21	6.1-6.5	Moderate--	Low.
75-100	70-100	65-90	60-80	40-50	20-30	0.06-0.2	0.14-0.16	5.1-5.5	High------	High.
100	100	85-95	60-75	25-35	10-20	0.63-2.0	0.16-0.18	5.1-5.5	Low-------	Moderate.
100	100	90-100	70-80	30-40	20-30	0.63-2.0	0.19-0.21	5.6-6.0	Moderate--	Moderate.
55-85	50-80	45-65	35-50	25-35	5-15	0.63-2.0	0.12-0.14	6.1-6.5	Low-------	Low.
45-70	45-65	40-60	35-50	30-40	20-30	0.63-2.0	0.12-0.14	6.1-6.5	Low-------	Moderate.
100	100	90-100	75-95	30-40	15-25	0.2-0.63	0.19-0.21	5.6-7.3	Moderate--	Moderate.
55-95	50-90	50-80	50-75	30-40	15-25	0.2-0.63	0.15-0.21	5.6-6.0	Moderate--	Moderate.
55-90	50-85	50-80	50-75	40-50	20-30	0.06-0.2	0.10-0.14	5.1-6.0	High------	High.

Soil series and map symbols	Depth to bedrock or hardpan	Depth to seasonal high water table	Depth from surface (typical profile)	Classification			More than 3 inches
				Dominant USDA texture	Unified	AASHO	
	Feet	Feet	Inches				Percent
Toomes: ToE, ToG-----	½-1½	(2/)	0-13	Clay loam and loam.	CL or ML	A-6	------
			13	Shattered basalt.			
Tuscan: TuC, TuE-----	1-2	(2/)	0-9	Cobbly clay loam.	SC	A-4 or A-6	5-20
			9-17	Very gravelly clay.	GC	A-2	5-15
			17	Indurated hard-pan.	---------	--------	-------
Wright: WgC, WhA, WmB, WoA.	>5	2-3	0-25	Loam and sandy clay loam.	ML	A-4	------
			25-62	Clay-------------	CL	A-7	------
Yolo: YlA, YmB, YnA, YoB, YrB, YsA, YtA.	>5	(2/)	0-60	Loam (Sandy loam, gravelly loam, silt loam, and clay loam surface layers are present in places.)	ML or CL	A-4 or A-6	------
*Yorkville: YuE, YuF, YvF, YwF, YwG. For properties of Laughlin soils in unit YvF, and of Suther soils in units YwF and YwG, refer to the respective series in this table.	2-5	(2/)	0-14	Clay loam--------	CL	A-6	------
			14-60	Clay-------------	CH	A-7	------
Zamora: ZaA, ZaB-----	>5	(2/)	0-55	Clay loam and sandy clay loam.	CL or ML	A-4 or A-6	------
			55-60	Gravelly clay----	CL	A-6	------

1/ Nonplastic.

Percentage passing sieve-- No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Atterberg values Liquid limit	Plastic index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity uncoated steel
						Inches per hour	Inches per inch of soil	pH value		
100	100	90-100	75-95	30-40	15-30	0.63-2.0	0.19-0.21	5.6-6.5	Moderate---	Moderate.
65-80	60-75	55-65	35-50	15-25	5-15	0.2-0.63	0.16-0.18	5.6-6.5	Moderate---	Moderate.
50-60	40-50	35-45	25-35	30-40	20-30	0.06-0.2	0.10-0.12	6.1-6.5	Low--------	Moderate.
------	-----	------	------	------	-----	<0.06	---------	------	-----------	---------
100	90-100	90-100	60-75	(1/)	(1/)	0.63-2.0	0.16-0.18	5.1-6.0	Low--------	High.
100	100	95-100	75-95	40-50	20-30	<0.06	0.04-0.06	4.5-7.3	High-------	High.
100	100	90-100	50-90	30-40	5-15	0.63-2.0	0.16-0.18	6.1-8.4	Low to moderate.	Low.
95-100	90-100	85-95	70-80	30-40	20-30	0.63-2.0	0.19-0.21	5.6-7.3	Moderate---	High.
100	100	90-100	75-95	50-60	30-40	<0.06	0.04-0.06	5.6-8.4	High-------	High.
100	95-100	85-95	50-65	20-30	5-20	0.2-0.63	0.19-0.21	6.1-7.3	Moderate---	Moderate.
75-85	70-80	60-75	55-70	30-40	20-30	0.2-0.63	0.12-0.14	6.6-7.3	High-------	High.

2/ Water table not observed within depth of examination. Normally this is at a depth of 5 feet unless limited by bedrock or hardpan.

TABLE 7.--ESTIMATED ENGINEERING

[The land types Alluvial land, sandy (AdA); Alluvial land, clayey (AeA); Coastal beaches (ChA); Dune land (DuE); variable that interpretations

An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or this reason, it is necessary to follow carefully the instructions for

Soil series and map symbols	Suitability as source of--		Soil features affecting--
	Topsoil	Road fill	Road location
Arbuckle: AgB, AgD, AgE, AkB, AkC.	Fair to good to depth of 27 inches. Poor below: gravelly clay.	Fair to depth of 27 inches: A-4. Poor below 27 inches: A-6.	Most features favorable: 0 to 30 percent slopes.
Atwell: AtF, AtG------------	Fair to depth of 28 inches: clay loam. Poor below 28 inches: clay and silty clay.	Poor: A-6 or A-7------	30 to 75 percent slopes; high shrink-swell potential.
Baywood: BaC, BaE-----------	Poor: loamy sand and sand.	Good-------------------	2 to 30 percent slopes-----
Blucher: BcA, BhA, BhB, BlA, BlB.	Good to depth of 34 inches. Fair below 34 inches: silty clay loam.	Poor: mostly A-6 or A-7.	$3\frac{1}{2}$ to 5 feet deep to water table; 0 to 5 percent slopes; moderate shrink-swell potential below depth of 34 inches.
Boomer: BoE, BoF, BoG-------	Good to depth of 19 inches. Fair below 19 inches: gravelly clay loam over basic igneous rock.	Fair to poor: A-4 to A-6.	$2\frac{1}{2}$ to 5 feet deep to rock; 15 to 75 percent slopes.
Caspar: CaE, CaF------------	Fair: mostly clay loam--	Good to fair to depth of 12 inches: A-2 or A-4. Poor below 12 inches: A-6 or A-7.	4 to more than 5 feet deep to rock; 15 to 50 percent slopes.

Gullied land (GuF); Riverwash (RnA); Rock land (RoG); Terrace escarpments (TeG); and Tidal marsh (TmA) are so have not been made

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for referring to other series that appear in the first column of this table]

Soil features affecting--Continued				Soil limitations for septic tank filter fields	Hydrologic soil group
Water retention		Agricultural drainage	Irrigation		
Embankments	Reservoir area				
Fair to poor strength; low to medium compressibility; fair to poor resistance to piping.	Moderately slow permeability; 0 to 30 percent slopes.	Drainage not needed.	High available water capacity; moderate intake rate; 0 to 30 percent slopes.	Severe: moderately slow permeability; a few slopes are more than 9 percent.	B
Fair to poor strength; medium to high compressibility; good to fair resistance to piping.	Very slow permeability; 30 to 75 percent slopes.	Drainage not needed.	Moderate available water capacity; slow intake rate; 30 to 75 percent slopes.	Severe: very slow permeability; 30 to 75 percent slopes.	C
Fair strength; slight compressibility; poor resistance to piping.	Rapid permeability; 2 to 30 percent slopes.	Drainage not needed.	Moderately low available water capacity; rapid intake rate; 2 to 30 percent slopes.	Slight to moderate for BaC: 2 to 9 percent slopes. Severe for BaE: 9 to 30 percent slopes.	A
Fair to poor strength; medium to low compressibility; fair to poor resistance to piping.	Slow permeability; 0 to 5 percent slopes.	Slow permeability; $3\frac{1}{2}$ to 5 feet deep to water table.	High available water capacity; moderate to slow intake rate; 0 to 5 percent slopes; $3\frac{1}{2}$ to 5 feet deep to water table.	Severe: slow permeability; $3\frac{1}{2}$ to 5 feet to water table.	C
Fair to poor strength; medium compressibility; fair to poor resistance to piping.	Moderate permeability; 15 to 75 percent slopes; $2\frac{1}{2}$ to 5 feet deep to rock.	Drainage not needed.	Moderate to high available water capacity; moderate intake rate; 15 to 75 percent slopes; $2\frac{1}{2}$ to 5 feet deep to rock.	Severe: 15 to 75 percent slopes; $2\frac{1}{2}$ to 5 feet to rock.	B
Fair to poor strength; medium compressibility; fair to poor resistance to piping.	Moderate permeability; 15 to 50 percent slopes; 4 to more than 5 feet deep to rock.	Drainage not needed.	Moderately high to high available water capacity; moderate intake rate; 15 to 50 percent slopes; 4 to more than 5 feet deep to rock.	Severe: 15 to 50 percent slopes; bedrock at 4 to more than 5 feet.	B

Soil series and map symbols	Suitability as source of--		Soil features affecting--
	Topsoil	Road fill	Road location
Cibo: CbF-----------------	Poor: clay and gravelly clay over basic igneous rock.	Poor: A-7---------------	$2\frac{1}{2}$ to $4\frac{1}{2}$ feet deep to rock; 15 to 50 percent slopes; high shrink-swell potential.
Clear Lake: CcA, CcB, CeA, CeB, CfA.	Poor: clay------------	Poor: A-7---------------	3 to 5 feet deep to water table; 0 to 5 percent slopes; high shrink-swell potential.
Clough: CgC, CgD, CgE-----	Poor: gravelly loam and very gravelly clay over hardpan.	Good to fair: A-2 to A-4.	1 to 3 feet deep to hardpan; 2 to 30 percent slopes.
Cohasset: CmE, CmF, CmG---	Fair: gravelly loam and gravelly clay loam over volcanic rock.	Fair to depth of 19 inches: A-4. Poor below: A-6.	$1\frac{1}{2}$ to 5 feet deep to rock; 15 to 75 percent slopes.
Cole: CnA, CnB, CoA, CoB--	Fair to depth of 45 inches: silty clay loam. Poor below 45 inches: clay.	Poor: A-6 and A-7-------	1 to 4 feet deep to water table; 0 to 5 percent slopes; high shrink-swell potential.
Comptche: CpG-------------	Fair to depth of 38 inches: gravelly clay loam. Poor below 38 inches: gravelly clay.	Poor: A-6 and A-7-------	$2\frac{1}{2}$ to 4 feet deep to rock; 30 to 75 percent slopes.

Soil features affecting--Continued: Water retention: Embankments	Water retention: Reservoir area	Agricultural drainage	Irrigation	Soil limitations for septic tank filter fields	Hydrologic soil group
Poor strength; high compressibility; good resistance to piping.	Slow permeability; 15 to 50 percent slopes; 2½ to 4½ feet deep to rock.	Drainage not needed.	Moderate available water capacity; slow intake rate; 15 to 50 percent slopes; 2½ to 4½ feet deep to rock.	Severe: slow permeability; 15 to 50 percent slopes; bedrock at 2½ to 4½ feet.	D
Poor strength; high compressibility; good resistance to piping.	Slow permeability; 0 to 5 percent slopes; 3 to 5 feet deep to water table.	Slow permeability; 3 to 5 feet deep to water table.	High available water capacity; slow intake rate; 0 to 5 percent slopes; 3 to 5 feet deep to water table.	Severe: slow permeability; 3 to 5 feet deep to water table.	D
Fair strength; low to medium compressibility; fair resistance to piping.	Very slow permeability; 2 to 30 percent slopes; 1 to 3 feet deep to hardpan.	Very slow permeability; 1 to 3 feet deep to hardpan.	Moderate to low available water capacity; moderate intake rate; 2 to 30 percent slopes; 1 to 3 feet deep to hardpan.	Severe: very slow permeability; 1 to 3 feet deep to hardpan; most slopes are 9 to 30 percent.	D
Fair strength; low to medium compressibility; fair resistance to piping.	Moderate permeability; 15 to 75 percent slopes; 1½ to 5 feet deep to rock.	Drainage not needed.	Moderate to low available water capacity; moderate intake rate; 15 to 75 percent slopes; 1½ to 5 feet deep to rock.	Severe: 15 to 75 percent slopes; 2 to 5 feet deep to rock.	B
Fair strength; medium to high compressibility; good resistance to piping.	Slow permeability; 0 to 5 percent slopes; 1 to 4 feet deep to water table.	Slow permeability; 1 to 4 feet deep to water table.	High available water capacity; moderate intake rate; 0 to 5 percent slopes; 1 to 4 feet deep to water table.	Severe: slow permeability; 1 to 4 feet deep to water table.	C
Fair strength; medium compressibility; good resistance to piping.	Moderately slow permeability; 30 to 75 percent slopes; 2½ to 4 feet deep to rock.	Drainage not needed.	Moderate available water capacity; moderate intake rate; 30 to 75 percent slopes; 2½ to 4 feet deep to rock.	Severe: moderately slow permeability; 30 to 75 percent slopes.	B

Soil series and map symbols	Suitability as source of--		Soil features affecting--
	Topsoil	Road fill	Road location
Cortina: CrA, CsA---------	Poor: very gravelly sandy loam and very gravelly loam.	Good---------------------	Most features favorable.
Cotati: CtC, CtD, CtE-----	Good to depth of 22 inches. Poor below 22 inches: clay.	Fair to depth of 22 inches: A-4. Poor below 22 inches: A-7.	2 to 30 percent slopes; high shrink-swell potential below depth of 22 inches.
Diablo: DbC, DbD, DbE, DbE2, DbF, DbF2.	Poor: clay--------------	Poor: A-7---------------	2 to 5 feet or more deep to rock; 2 to 50 percent slopes; high shrink-swell potential.
Dibble: DcC, DcD, DcE, DcE2, DcF, DcF2.	Fair to depth of 16 inches: clay loam. Poor below 16 inches: clay.	Poor: A-6 or A-7--------	2½ to 5 feet deep to rock; 2 to 50 percent slopes; high shrink-swell potential below depth of 16 inches.
*Empire: EmE, EmF, EpF---- (For properties of Caspar soils in unit EpF, refer to Caspar series in this table.)	Good to depth of 19 inches. Fair below 19 inches: silty clay loam.	Fair to depth of 19 inches: A-4. Poor below 19 inches: A-6.	2½ to 5 feet deep to rock; 9 to 50 percent slopes.
Felta: FaD, FaE, FaF, FaG.	Poor: very gravelly clay loam.	Good---------------------	5 to 75 percent slopes-

Soil features affecting--Continued				Soil limitations for septic tank filter fields	Hydrologic soil group
Water retention		Agricultural drainage	Irrigation		
Embankments	Reservoir area				
Good strength; low compressibility; good resistance to piping.	Very rapid permeability; 0 to 2 percent slopes.	Drainage not needed.	Low available water capacity; rapid intake rate; 0 to 2 percent slopes.	Slight---------------	A
Fair to poor strength; medium compressibility; good to fair resistance to piping.	Slow permeability; 2 to 30 percent slopes.	Slow permeability.	Moderate to low available water capacity; moderate intake rate; 2 to 30 percent slopes.	Severe: slow permeability; most slopes are 9 to 30 percent.	C
Poor strength; high compressibility; good resistance to piping.	Slow permeability; 2 to 50 percent slopes; 2 to 5 feet or more deep to rock.	Slow permeability; 2 to 5 feet or more deep to rock.	Moderate to high available water capacity; slow intake rate; 2 to 50 percent slopes; 2 to 5 feet or more deep to rock.	Severe: slow permeability; most slopes are 2 to 50 percent; 2 to 5 feet or more deep to rock.	D
Fair strength; medium compressibility; good resistance to piping.	Slow permeability; $2\frac{1}{2}$ to 5 feet deep to rock.	Slow permeability; $2\frac{1}{2}$ to 5 feet deep to rock.	Moderate available water capacity; moderate intake rate; 2 to 50 percent slopes; $2\frac{1}{2}$ to 5 feet deep to rock.	Severe: slow permeability; 2 to 50 percent slopes; $2\frac{1}{2}$ to 5 feet deep to rock.	C
Fair to poor strength; medium to high compressibility; fair to poor resistance to piping.	Moderately slow permeability; 9 to 50 percent slopes; $2\frac{1}{2}$ to 5 feet deep to rock.	Drainage not needed.	High available water capacity; moderately slow intake rate; 9 to 50 percent slopes; $2\frac{1}{2}$ to 5 feet deep to rock.	Severe: moderately slow permeability; 9 to 50 percent slopes; $2\frac{1}{2}$ to 5 feet deep to rock.	B
Fair strength; low compressibility; good resistance to piping.	Moderate permeability; 5 to 75 percent slopes.	Drainage not needed.	Moderate available water capacity; moderate intake rate; 5 to 75 percent slopes.	Moderate to severe: 5 to 75 percent slopes.	B

Soil series and map symbols	Suitability as source of--		Soil features affecting--
	Topsoil	Road fill	Road location
*Forward: FoE, FoG, FrG--- (For properties of Kidd soil in unit FrG, refer to Kidd series in this table.)	Fair: gravelly sandy clay loam.	Good: A-2--------------	$1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock; 9 to 75 percent slopes.
Goldridge: GdC, GdD, GdD2, GdE, GdE2, GdF, GdF2.	Good to depth of 28 inches. Fair below 28 inches: sandy clay loam.	Fair to poor: A-4 to A-6.	$3\frac{1}{2}$ to 5 feet or more deep to rock; 2 to 50 percent slopes.
*Goulding: GgD, GgE, GgF, GgF2, GgG, GlD, GlE, GlF, GlF2, GlG, GoF. (For properties of Toomes soils in unit GoF, refer to Toomes series in this table.)	Fair to depth of 11 inches for clay loam but poor for cobbly clay loam. Poor below 11 inches: very gravelly clay loam.	Poor to depth of 11 inches: A-6. Good below 11 inches: A-2.	1 to 2 feet deep to rock; 5 to 75 percent slopes; cobbly surface in some areas.
Guenoc: GrE, GrG-----------	Fair to depth of 26 inches: gravelly silt loam and clay loam. Poor below 26 inches: clay.	Poor: A-6---------------	$1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock; 5 to 75 percent slopes.
*Haire: HaB, HbC, HbD, HbD2, HbE, HcC, HcD, HcD2, HcE, HcE2.	Good to fair to depth of 24 inches: fine sandy loam, gravelly loam, and clay loam. Poor below 24 inches: clay over very gravelly and cobbly clay loam.	Fair to poor to depth of 24 inches: A-4 and A-6. Poor to depth of 24 to 36 inches: A-7. Good below 36 inches: A-2.	0 to 30 percent slopes; high shrink-swell potential below depth of 24 inches.
Hely: HeF, HeG-------------	Good to depth of 29 inches: silt loam.	Fair: A-4---------------	$1\frac{1}{2}$ to 4 feet deep to rock; 30 to 75 percent slopes.

Soil features affecting--Continued				Soil limitations for septic tank filter fields	Hydrologic soil group
Water retention		Agricultural drainage	Irrigation		
Embankments	Reservoir area				
Fair strength; medium compressibility; fair resistance to piping.	Moderate permeability; 9 to 75 percent slopes; $1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock.	Drainage not needed.	Low available water capacity; moderate intake rate; 9 to 75 percent slopes; $1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock.	Severe: $1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock; 9 to 75 percent slopes.	C
Poor to fair strength; medium compressibility; fair to poor resistance to piping.	Moderately slow permeability; 2 to 50 percent slopes; $3\frac{1}{2}$ to 5 feet or more to rock.	Drainage not needed.	High available water capacity; moderately slow intake rate; 2 to 50 percent slopes; $3\frac{1}{2}$ to 5 feet or more deep to rock.	Severe: moderately slow permeability; most slopes are 9 to 75 percent; $3\frac{1}{2}$ to 5 feet or more to rock.	B
Fair strength; medium compressibility; good resistance to piping.	Moderate permeability; 5 to 75 percent slopes; 1 to 2 feet deep to rock.	Drainage not needed.	Moderate to low available water capacity; moderate intake rate; 5 to 75 percent slopes; 1 to 2 feet deep to rock.	Severe: 1 to 2 feet deep to rock; most slopes are 9 to 75 percent.	D
Fair to poor strength; medium compressibility; fair to good resistance to piping.	Moderately slow permeability; 5 to 75 percent slopes; $1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock.	Drainage not needed.	Moderate available water capacity; moderate intake rate; 5 to 75 percent slopes; $1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock.	Severe: moderately slow permeability; most slopes are 9 to 75 percent; $1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock.	C
Fair to poor strength; medium to high compressibility; good resistance to piping.	Slow permeability; 0 to 30 percent slopes.	Slow permeability.	Low to moderate available water capacity; moderate to slow intake rate; 0 to 30 percent slopes.	Severe: slow permeability; most slopes are 9 to 30 percent.	C
Poor strength; medium compressibility; poor resistance to piping.	Moderate permeability; 30 to 75 percent slopes; $1\frac{1}{2}$ to 4 feet deep to rock.	Drainage not needed.	Moderate available water capacity; moderate intake rate; 30 to 75 percent slopes; $1\frac{1}{2}$ to 4 feet deep to rock.	Severe: 30 to 75 percent slopes; $1\frac{1}{2}$ to 4 feet deep to rock.	C

Soil series and map symbols	Suitability as source of--		Soil features affecting--
	Topsoil	Road fill	Road location
Henneke: HgE, HgG2	Poor: gravelly loam and very gravelly clay.	Good	1 to 1½ feet to rock; 5 to 75 percent slopes.
*Hugo: HhF, HkF, HkG, HkG2, HlF, HlG, HmF, HmG, HnE, HnG, HnG2, HoG, HrG, HsF, HsG. (For properties of the Atwell soil in unit HlF and HlG, the Boomer soil in units HmF and HmG, the Josephine soil in units HnE, HnG, and HnG2, the Laughlin soil in unit HoG, the Los Gatos soil in unit HrG, and the Hely soils in units HsF and HsG, see their respective series in this table.)	Good to fair to depth of 48 inches: loam, very gravelly loam, and gravelly sandy clay loam.	Fair to poor: A-4 to A-6.	2½ to 5 feet deep to rock; 9 to 75 percent slopes.
Huichica:			
HtA, HtC, HtD, HvC	Good to depth of 23 inches: loam. Poor below 23 inches: clay.	Fair to poor: A-4, A-6, or A-7.	0 to 15 percent slopes; high shrink-swell potential below depth of 23 inches.
HuB, HwB	Good to depth of 23 inches: loam. Poor below 23 inches: clay.	Fair to poor: A-4, A-6, or A-7.	1 to 2 feet deep to water table; 0 to 5 percent slopes; high shrink-swell potential below depth of 23 inches.
Huse: HyG	Poor: very low fertility.	Poor: A-6	1 to 2 feet deep to rock; 30 to 75 percent slopes; moderate shrink-swell potential; stony.

Soil features affecting--Continued: Water retention: Embankments	Soil features affecting--Continued: Water retention: Reservoir area	Agricultural drainage	Irrigation	Soil limitations for septic tank filter fields	Hydrologic soil group
Fair strength; low compressibility; good resistance to piping.	Moderately slow permeability; 5 to 75 percent slopes; 1 to 1½ feet deep to rock.	Drainage not needed.	Low available water capacity; moderate intake rate; 5 to 75 percent slopes; 1 to 1½ feet deep to rock.	Severe: 1 to 1½ feet deep to rock; 5 to 75 percent slopes.	D
Fair strength; medium compressibility; good resistance to piping.	Moderate permeability; 9 to 75 percent slopes; 2½ to 5 feet deep to rock.	Drainage not needed.	Moderate available water capacity; moderate intake rate; 9 to 75 percent slopes; 2½ to 5 feet deep to rock.	Severe: 9 to 75 percent slopes; 2½ to 5 feet deep to bedrock.	B
Fair to poor strength; medium compressibility; poor to good resistance to piping.	Very slow permeability; 0 to 15 percent slopes.	Very slow permeability.	Moderate available water capacity; moderate intake rate; 0 to 15 percent slopes.	Severe: very slow permeability; 2 to 3½ feet deep to hardpan.	D
Poor strength; medium to high compressibility; poor resistance to piping.	Very slow permeability; 0 to 5 percent slopes; 1 to 2 feet deep to water table.	Very slow permeability; 1 to 2 feet deep to water table.	Moderate available water capacity; moderate intake rate; 0 to 5 percent slopes; 1 to 2 feet deep to water table.	Severe: very slow permeability; 1 to 2 feet deep to water table; 2 to 3½ feet deep to hardpan.	D
Fair to poor strength; medium compressibility; good resistance to piping.	Moderate permeability; 30 to 75 percent slopes; 1 to 2 feet deep to rock.	Drainage not needed.	Low available water capacity; moderate intake rate; 30 to 75 percent slopes; 1 to 2 feet deep to rock.	Severe: 30 to 75 percent slopes; 1 to 2 feet deep to rock.	C

Soil series and map symbols	Suitability as source of--		Soil features affecting--
	Topsoil	Road fill	Road location
*Josephine: JoE, JoF, JoF2, JoG, JsG. (For properties of Sites soils in unit JsG, see the Sites series in this table.)	Good to depth of 13 inches: loam. Fair to depth of 36 inches: clay loam, and fine sandy loam.	Fair to poor: A-4 to A-6.	2 to 5 feet or more deep to rock; 9 to 75 percent slopes.
Kidd: KdF, KeE, KkG----------	Fair to depth of 15 inches: gravelly loam over rhyolite.	Fair to poor: A-4 or A-6.	1 to 1½ feet deep to rock; 2 to 75 percent slopes; KeE is stony, and KkG is very rocky.
*Kinman: KlD, KlE, KlF, KmF-- (For properties of Kneeland soil in unit KmF, see the Kneeland series in this table.)	Poor: mostly clay over sandstone.	Poor: A-6 or A-7-------	2½ to 5 feet or more deep to rock; 5 to 50 percent slopes; high shrink-swell potential below depth of 12 inches.
Kneeland: KnC, KnD, KnE, KnF, KoG.	Good to depth of 13 inches: loam. Fair below 13 inches: clay loam.	Poor: A-6--------------	2 to 4 feet deep to rock; 5 to 75 percent slopes; numerous rock outcrops in KoG.
Kneeland, sandy variant: KsD, KsE, KvE.	Good to depth of 18 inches: sandy loam. Poor below 18 inches: loamy coarse sand over sandstone.	Good--------------------	1 to 3 feet deep to rock; 2 to 30 percent slopes; KvE is rocky.
Laniger: LaC, LaD, LaE, LaE2, LaF.	Good to depth of 29 inches: loam over rhyolite.	Poor: A-6--------------	1½ to 4 feet deep to rock; 9 to 50 percent slopes.

Soil features affecting--Continued: Water retention: Embankments	Soil features affecting--Continued: Water retention: Reservoir area	Agricultural drainage	Irrigation	Soil limitations for septic tank filter fields	Hydrologic soil group
Fair to poor strength; medium compressibility; fair to poor resistance to piping.	Moderate permeability; 9 to 75 percent slopes; 2 to 5 feet or more deep to rock.	Drainage not needed.	Moderate to high available water capacity; moderate intake rate; 9 to 75 percent slopes; 2 to 5 feet or more deep to rock.	Severe: 9 to 75 percent slopes; 2 to 5 feet or more deep to rock.	B
Fair strength; medium compressibility; fair resistance to piping.	Rapid permeability; 2 to 75 percent slopes; 1 to 2 feet deep to rock.	Drainage not needed.	Low available water capacity; moderate intake rate; 2 to 75 percent slopes; ½ to 1½ feet deep to rock.	Severe: ½ to 1½ feet deep to rock; most slopes are 9 to 75 percent.	D
Poor strength; medium to high compressibility; good resistance to piping.	Slow permeability; 5 to 50 percent slopes; 2½ to 5 feet or more deep to rock.	Slow permeability; 2½ to 5 feet or more deep to rock.	Moderate available water capacity; moderately slow intake rate; 5 to 50 percent slopes; 2½ to 5 feet or more deep to rock.	Severe: slow permeability; 5 to 50 percent slopes; 2½ to 5 feet or more deep to rock.	C
Fair to poor strength; medium compressibility; good resistance to piping.	Moderate permeability; 5 to 75 percent slopes; 2 to 4 feet deep to rock.	Drainage not needed.	Moderate available water capacity; moderate intake rate; 5 to 75 percent slopes; 2 to 4 feet deep to rock.	Severe: 2 to 4 feet deep to rock; 5 to 75 percent slopes.	C
Fair strength; slight compressibility; poor resistance to piping.	Moderately rapid permeability; 2 to 30 percent slopes; 1 to 3 feet deep to rock.	Drainage not needed.	Low to moderate available water capacity; moderately rapid intake rate; 2 to 30 percent slopes; 1 to 3 feet deep to rock.	Severe: 1 to 3 feet deep to rock; most slopes are 9 to 30 percent.	C
Fair to poor strength; medium compressibility; fair to poor resistance to piping.	Moderate permeability; 9 to 50 percent slopes; 1½ to 4 feet deep to rock.	Drainage not needed.	Low to moderate available water capacity; moderate intake rate; 9 to 50 percent slopes; 1½ to 4 feet deep to rock.	Severe: 1½ to 4 feet deep to rock; 9 to 50 percent slopes.	C

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Soil series and map symbols	Suitability as source of-- Topsoil	Suitability as source of-- Road fill	Soil features affecting-- Road location
*Laughlin: LgE, LgF, LgG, LgG2, LhG. (For properties of Yorkville soils in unit LhG, see the Yorkville series in this table.)	Good to fair to depth of 22 inches: loam and sandy clay loam.	Poor: A-6---------------	1 to 3 feet deep to rock; 2 to 75 percent slopes.
*Los Gatos: LkG, LmG, LnG-- (For properties of Josephine soil in unit LnG, see Josephine series in this table.)	Good to fair: loam, gravelly loam, and gravelly clay loam.	Fair to poor: A-4 or A-6.	2 to 4 feet deep to rock; 30 to 75 percent slopes.
Los Osos: LoD, LoE, LoF, LoF2, LsD, LsE, LsE2, LsF2.	Fair to depth of 16 inches: clay loam. Poor below 16 inches: clay.	Poor: A-6 or A-7--------	$1\frac{1}{2}$ to 4 feet deep to rock; 2 to 50 percent slopes; high shrink-swell potential below depth of 16 inches.
Los Robles: LuA, LvB-------	Fair for LuA: gravelly clay loam. For LvB, fair to depth of 42 inches: gravelly clay loam. Poor below 42 inches: gravel, cobblestones, and stones.	Poor: A-6---------------	Most features favorable--
Manzanita: MbC-------------	Fair: gravelly silt loam and clay loam.	Poor: A-6---------------	High shrink-swell potential.
*Maymen: McF, MlG---------- (For properties of the Los Gatos soil in unit MlG, see the Los Gatos series in this table.)	Fair to depth of 18 inches: gravelly sandy loam and gravelly loam.	Good---------------------	1 to $1\frac{1}{2}$ feet deep to rock; 30 to 75 percent slopes.

Soil features affecting--Continued				Soil limitations for septic tank filter fields	Hydrologic soil group
Water retention		Agricultural drainage	Irrigation		
Embankments	Reservoir area				
Fair strength; medium compressibility; good to fair resistance to piping.	Moderate permeability; 2 to 75 percent slopes; 1 to 3 feet deep to rock.	Drainage not needed.	Low available water capacity; moderate intake rate; 2 to 75 percent slopes; 1 to 3 feet deep to rock.	Severe: 1 to 3 feet deep to rock; most slopes are 9 to 75 percent.	C
Fair strength; medium to high compressibility; good resistance to piping.	Moderately slow permeability; 30 to 75 percent slopes; 2 to 4 feet deep to rock.	Drainage not needed.	Low to moderate available water capacity; moderate intake rate; 30 to 75 percent slopes; 2 to 4 feet deep to rock.	Severe: moderately slow permeability; 30 to 75 percent slopes.	C
Fair to poor strength; medium compressibility; fair resistance to piping.	Slow permeability; 2 to 50 percent slopes; 1½ to 4 feet deep to rock.	Slow permeability; 1½ to 4 feet deep to rock.	Low to moderate available water capacity; slow intake rate; 2 to 50 percent slopes.	Severe: slow permeability; most slopes are more than 9 percent; 1½ to 4 feet deep to rock.	C
Fair strength; low compressibility; good resistance to piping.	Moderately slow permeability for LuA. Rapid permeability for LvB below depth of 42 inches.	Moderately slow permeability for LuA, rapid permeability below depth of 42 inches in LvB.	Moderate to high available water capacity; moderate intake rate.	Severe: moderately slow permeability.	B
Fair to poor strength; medium compressibility; good resistance to piping.	Moderately slow permeability.	Moderately slow permeability.	High available water capacity; moderate intake rate; 0 to 9 percent slopes.	Severe: moderately slow permeability; 0 to 9 percent slopes.	B
Fair strength; medium compressibility; poor resistance to piping.	Moderate permeability; 30 to 75 percent slopes; 1 to 1½ feet deep to rock.	Drainage not needed.	Low available water capacity; moderate intake rate; 30 to 75 percent slopes; 1 to 1½ feet deep to rock.	Severe: 30 to 75 percent slopes; 1 to 1½ feet deep to rock.	D

Soil series and map symbols	Suitability as source of-- Topsoil	Suitability as source of-- Road fill	Soil features affecting-- Road location
*Mendocino: MmE, MmF, MnF-- (For properties of the Empire soils in unit MnF, see the Empire series in this table.)	Fair to depth of 26 inches: sandy clay loam. Poor below 26 inches: sandy clay.	Poor: A-6---------------	$2\frac{1}{2}$ to 5 feet deep to rock; 0 to 50 percent slopes; moderate shrink-swell potential.
Montara: MoE, MoG----------	Poor: very low fertility.	Fair to poor: A-4 or A-6.	$\frac{1}{2}$ to $1\frac{1}{2}$ feet deep to rock; 2 to 75 percent slopes; cobbly.
Noyo: NoD------------------	Fair to depth of 29 inches: sandy loam. Poor below 29 inches: clay and loamy sand.	Good to depth of 29 inches. Poor from depth of 29 to 53 inches: A-7. Good below 53 inches: A-2.	0 to 15 percent slopes----
Pajaro: PaA, PaB, PbB, PcA, PcB.	Good: fine sandy loam. Fair in places: gravelly loam or clay loam.	Fair to depth of 72 inches: A-4.	3 to 5 feet to water table; low shrink-swell potential.
*Pleasanton: PeA, PeC, PgB, PhB, PkC, PlC, PlD. (For properties of Haire soils in units PlC and PlD, see Haire series in this table.)	Good to fair: loam, gravelly loam, clay loam, or gravelly clay loam.	Fair to poor: A-4 or A-6.	0 to 15 percent slopes----
Positas: PsC, PsD---------	Fair to depth of 22 inches: gravelly loam and clay loam. Poor below 22 inches: clay and gravelly clay.	Poor: mostly A-6 or A-7.	0 to 15 percent slopes; high shrink-swell potential.

Soil features affecting--Continued: Water retention: Embankments	Soil features affecting--Continued: Water retention: Reservoir area	Agricultural drainage	Irrigation	Soil limitations for septic tank filter fields	Hydrologic soil group
Fair strength; medium compressibility; good resistance to piping.	Moderately slow permeability; 0 to 50 percent slopes; 2½ to 5 feet deep to rock.	Moderately slow permeability; 2½ to 5 feet deep to rock.	Moderate to high available water capacity; slow intake rate; 0 to 50 percent slopes; 2½ to 5 feet deep to rock.	Severe: moderately slow permeability; most slopes are 9 to 50 percent; 2½ to 5 feet deep to rock.	B
Fair strength; medium compressibility; good resistance to piping.	Moderately slow permeability; 0 to 75 percent slopes; ½ to 1½ feet deep to rock.	Drainage not needed.	Low available water capacity; slow intake rate; 0 to 75 percent slopes; ½ to 1½ feet deep to rock.	Severe: moderately slow permeability; ½ to 1½ feet deep to rock; 0 to 75 percent slopes.	D
Fair strength; medium compressibility; fair to good resistance to piping.	Slow permeability; 0 to 15 percent slopes.	Slow permeability.	Moderate available water capacity; rapid intake rate; 0 to 15 percent slopes; 2 to 4 feet deep to water table.	Severe: slow permeability.	C
Fair strength; medium compressibility; poor to fair resistance to piping.	Moderately slow permeability; 0 to 5 percent slopes; 3 to 5 feet deep to water table.	Moderately slow permeability; 3 to 5 feet deep to water table.	High available water capacity; moderate to slow intake rate; 0 to 5 percent slopes; 3 to 5 feet deep to water table.	Severe: moderately slow permeability; 3 to 5 feet deep to water table.	C
Fair strength; medium compressibility; fair to poor resistance to piping.	Moderately slow permeability; 0 to 15 percent slopes.	Moderately slow permeability.	High available water capacity; moderately slow intake rate; 0 to 15 percent slopes.	Severe: moderately slow permeability.	B
Fair to poor strength; medium to high compressibility; fair to good resistance to piping.	Very slow permeability; 0 to 15 percent slopes.	Very slow permeability.	Moderate available water capacity; moderate intake rate; 0 to 15 percent slopes.	Severe: very slow permeability.	D

Soil series and map symbols	Suitability as source of-- Topsoil	Suitability as source of-- Road fill	Soil features affecting-- Road location
*Raynor: RaC, RaD, RaE, RcD, ReE. (For properties of the Montara soil in unit ReE, see the Montara series in this table.)	Poor: clay over very cobbly and stony clay.	Poor: A-7	$1\frac{1}{2}$ to 5 feet to rock; 2 to 30 percent slopes; high shrink-swell potential.
Red Hill: RhD, RhE, RhF, RlG.	Fair to depth of 50 inches: clay loam. Poor below 50 inches: clay.	Poor: A-6 or A-7	2 to 75 percent slopes; high shrink-swell potential below depth of 50 inches; RlG has cobbly surface layer.
Reyes: RmA	Poor: silty clay	Poor: A-7 or A-8	0 to 4 feet deep to water table; high shrink-swell potential.
Rohnerville: RrC, RrD	Good to depth of 16 inches: loam. Fair to poor below 16 inches: sandy clay loam and sandy clay.	Poor: A-6	0 to 15 percent slopes; moderate shrink-swell potential.
Sebastopol: SbC, SbD, SbD2, SbE.	Fair to depth of 18 inches: sandy loam and clay loam. Poor below 18 inches: clay and heavy clay loam.	Poor: A-6 or A-7	2 to 30 percent slopes; moderate shrink-swell potential below depth of 18 inches.
Sheridan: SeE	Fair to depth of 47 inches: coarse sandy loam.	Good	3 to 5 feet deep to rock; 2 to 30 percent slopes.

Soil features affecting--Continued				Soil limitations for septic tank filter fields	Hydrologic soil group
Water retention		Agricultural drainage	Irrigation		
Embankments	Reservoir area				
Poor strength; high compressibility; good resistance to piping.	Slow permeability; 0 to 30 percent slopes; 1½ to 5 feet deep to rock.	Slow permeability; 1½ to 5 feet deep to rock.	High available water capacity; moderate intake rate; 0 to 30 percent slopes; 1½ to 5 feet deep to rock.	Severe: slow permeability; 0 to 30 percent slopes; 1½ to 5 feet deep to rock.	D
Fair to poor strength; medium compressibility; good resistance to piping.	Moderately slow permeability; 2 to 75 percent slopes.	Moderately slow permeability.	High available water capacity; moderately slow intake rate; 2 to 75 percent slopes.	Severe: moderately slow permeability; most slopes are 9 to 75 percent.	B
Poor strength; very high compressibility; fair to poor resistance to piping.	Slow permeability; 0 to 4 feet deep to water table.	High available water capacity; slow intake rate.	High available water capacity; slow intake rate.	Severe: slow permeability; 0 to 4 feet deep to water table.	D
Fair to poor strength; medium compressibility; fair to good resistance to piping.	Moderately slow permeability; 0 to 15 percent slopes.	Moderately slow permeability.	Moderate available water capacity; moderate intake rate; 0 to 15 percent slopes.	Severe: moderately slow permeability.	B
Fair to poor strength; medium compressibility; good resistance to piping.	Moderately slow permeability; 2 to 30 percent slopes.	Moderately slow permeability.	High available water capacity; moderately rapid intake rate; 2 to 30 percent slopes.	Severe: moderately slow permeability; 2 to 30 percent slopes.	B
Fair strength; low compressibility; poor resistance to piping.	Moderately rapid permeability; 2 to 30 percent slopes; 3 to 5 feet deep to rock.	Drainage not needed.	Moderate available water capacity; rapid intake rate; 2 to 30 percent slopes; 3 to 5 feet deep to rock.	Severe: 2 to 30 percent slopes; 3 to 5 feet deep to rock.	B

Soil series and map symbols	Suitability as source of--		Soil features affecting--
	Topsoil	Road fill	Road location
Sites: SfE, SfF------------	Poor: mostly clay over sandstone.	Fair to poor: A-4, A-6, or A-7.	3 to 5 feet or more deep to rock; 5 to 50 percent slopes; moderate shrink-swell potential.
Sobrante: ShE, ShF, ShG----	Fair to depth of 20 inches: mostly clay loam.	Poor: A-6----------------	$1\frac{1}{2}$ to $3\frac{1}{2}$ feet deep to rock; 15 to 75 percent slopes.
Spreckels: SkC, SkD, SkE, SkE2, SkF.	Good to fair to depth of 18 inches: loam and clay loam. Poor below 18 inches: clay.	Poor: A-6 or A-7---------	2 to 5 feet deep to rock; 2 to 50 percent slopes; high shrink-swell potential.
Steinbeck: SnC, SnD, SnD2, SnE, SnE2, SnF, SnF2.	Good to depth of 35 inches: loam. Fair below 35 inches: clay loam.	Poor: A-6----------------	$1\frac{1}{2}$ to 5 feet or more deep to rock; 2 to 50 percent slopes.
*Stonyford: SoF, SoG, SrG--- (For properties of the Boomer soil in unit SrG, see the Boomer series in this table.)	Poor to depth of 19 inches: mostly very gravelly clay loam.	Fair to poor: A-4 or A-6.	1 to 2 feet deep to rock; 30 to 75 percent slopes.
Supan: SsG------------------	Mostly fair to depth of 39 inches: clay loam.	Poor: A-6----------------	$2\frac{1}{2}$ to $4\frac{1}{2}$ feet deep to rock; 30 to 75 percent slopes; moderate shrink-swell potential.

Soil features affecting--Continued				Soil limitations for septic tank filter fields	Hydrologic soil group
Water retention		Agricultural drainage	Irrigation		
Embankments	Reservoir area				
Fair to poor strength; medium compressibility; fair to poor resistance to piping.	Moderately slow permeability; 5 to 50 percent slopes; 3 to 5 feet or more deep to rock.	Moderately slow permeability; 3 to 5 feet or more deep to rock.	Moderate to high available water capacity; slow intake rate; 5 to 50 percent slopes; 3 to 5 feet or more deep to rock.	Severe: moderately slow permeability; 5 to 50 percent slopes; 3 to 5 feet or more deep to rock.	B
Fair to poor strength; medium compressibility; poor to good resistance to piping.	Moderate permeability; 15 to 75 percent slopes; 1½ to 3½ feet deep to rock.	Drainage not needed.	Low to moderate available water capacity; moderate intake rate; 15 to 75 percent slopes; 1½ to 3½ feet deep to rock.	Severe: 15 to 75 percent slopes; 1½ to 3½ feet deep to rock.	C
Fair to poor strength; medium compressibility; fair to good resistance to piping.	Slow permeability; 2 to 50 percent slopes; 2 to 5 feet deep to rock.	Slow permeability; 2 to 5 feet deep to rock.	Low to moderate available water capacity; moderate intake rate; 2 to 50 percent slopes; 2 to 5 feet deep to rock.	Severe: slow permeability; most slopes are 9 to 50 percent; 2 to 5 feet deep to rock.	C
Fair to poor strength; medium compressibility; good resistance to piping.	Moderate permeability; 2 to 50 percent slopes; 1½ to 5 feet or more deep to rock.	Drainage not needed.	Moderate to low available water capacity; moderate intake rate; 2 to 50 percent slopes; 1½ to 5 feet or more deep to rock.	Moderate to severe: moderate permeability; 2 to 50 percent slopes; 1½ to 5 feet or more deep to rock.	B
Fair strength; medium compressibility; poor to good resistance to piping.	Moderate permeability; 30 to 75 percent slopes; 1 to 2 feet deep to rock.	Drainage not needed.	Low available water capacity; moderately rapid intake rate; 30 to 75 percent slopes; 1 to 2 feet deep to rock.	Severe: 30 to 75 percent slopes; 1 to 2 feet deep to rock.	D
Fair to poor strength; medium compressibility; good resistance to piping.	Moderately slow permeability; 30 to 75 percent slopes; 2½ to 4½ feet deep to rock.	Drainage not needed.	Moderate available water capacity; moderate intake rate; 30 to 75 percent slopes; 2½ to 4½ feet deep to rock.	Severe: moderately slow permeability; 30 to 75 percent slopes; 2½ to 4½ feet deep to rock.	C

Soil series and map symbols	Suitability as source of--		Soil features affecting--
	Topsoil	Road fill	Road location
*Suther: StE, StE2, StF, SuF, SuG. (For properties of Laughlin soils in units SuF and SuG, see Laughlin series in this table.)	Fair to depth of 14 inches: clay loam. Poor below 14 inches: gravelly clay.	Poor: A-6 or A-7-------	1½ to 3½ feet deep to rock; 15 to 75 percent slopes; high shrink-swell potential.
Toomes: ToE, ToG-----------	Fair to depth of 13 inches: clay loam.	Poor: A-6--------------	½ to 1½ feet deep to rock; 2 to 75 percent slopes; rocky.
Tuscan: TuC, TuE-----------	Poor: cobbly clay loam and very gravelly clay.	Good to poor: A-2, A-4, and A-6.	1 to 2 feet deep to hardpan; 0 to 30 percent slopes; cobbly.
Wright: WgC, WhA, WmB, WoA.	Good to depth of 25 inches: loam. Poor below 25 inches: clay.	Fair to depth of 25 inches: A-4. Poor below 25 inches: A-7.	2 to 3 feet deep to water table; 0 to 9 percent slopes; high shrink-swell potential.
Yolo: YlA, YmB, YnA, YoB, YrB, YsA, YtA.	Good for YnA, YrB, YsA: loam and silt loam. Fair to depth of 15 inches: sandy loam, gravelly loam, and clay loam. Good below 15 inches: loam.	Fair to poor: A-4 to A-6.	Most features favorable--
*Yorkville: YuE, YuF, YvF, YwF, YwG. (For properties of Laughlin soils in unit YvF and Suther soils in units YwF and YwG, see their respective series.)	Fair to depth of 19 inches: clay loam. Poor below 19 inches: clay.	Poor: A-6 or A-7-------	2 to 5 feet deep to rock; 5 to 75 percent slopes; high shrink-swell potential.
Zamora: ZaA, ZaB-----------	Fair to depth of 55 inches: clay loam. Poor below 55 inches: gravelly clay.	Fair to poor: A-4 or A-6.	High shrink-swell potential below depth of 55 inches.

Soil features affecting--Continued				Soil limitations for septic tank filter fields	Hydrologic soil group
Water retention		Agricultural drainage	Irrigation		
Embankments	Reservoir area				
Fair to poor strength; medium compressibility; good resistance to piping.	Slow permeability; 15 to 75 percent slopes; 1½ to 3½ feet deep to rock.	Drainage not needed.	Low to moderate available water capacity; moderate intake rate; 15 to 75 percent slopes; 1½ to 3½ feet deep to rock.	Severe: slow permeability; 15 to 75 percent slopes; 1½ to 3½ feet to rock.	C
Fair to poor strength; medium compressibility; fair to poor resistance to piping.	Moderate permeability; 2 to 75 percent slopes; ½ to 1½ feet deep to rock.	Drainage not needed.	Low available water capacity; moderate intake rate; 2 to 75 percent slopes; ½ to 1½ feet deep to rock.	Severe: ½ to 1½ feet deep to rock; most slopes are 9 to 75 percent.	D
Fair strength; medium compressibility; good resistance to piping.	Very slow permeability; 0 to 30 percent slopes; 1 to 2 feet deep to hardpan.	Very slow permeability; 1 to 2 feet deep to hardpan.	Low available water capacity; slow intake rate; 0 to 30 percent slopes; 1 to 2 feet deep to hardpan.	Severe: very slow permeability; 1 to 2 feet deep to hardpan.	D
Fair to poor strength; medium compressibility; fair to good resistance to piping.	Very slow permeability; 0 to 9 percent slopes; 2 to 3 feet deep to water table.	Very slow permeability; 2 to 3 feet deep to water table.	Low to moderate available water capacity; moderate intake rate; 0 to 9 percent slopes; 2 to 3 feet deep to water table.	Severe: very slow permeability; 2 to 3 feet deep to water table.	C
Fair to poor strength; medium compressibility; poor to good resistance to piping.	Moderate permeability; 0 to 5 percent slopes.	Drainage not needed.	High available water capacity; moderate intake rate; 0 to 5 percent slopes.	Moderate: moderate permeability. Severe for YmB, YoB: subject to flooding	B
Fair to poor strength; medium to high compressibility; good resistance to piping.	Very slow permeability; 5 to 75 percent slopes; 2 to 5 feet deep to rock.	Very slow permeability; 5 to 75 percent slopes; 2 to 5 feet deep to rock.	Moderate to high available water capacity; slow intake rate; 5 to 75 percent slopes; 2 to 5 feet deep to rock.	Severe: very slow permeability; most slopes are 9 to 75 percent; 2 to 5 feet deep to rock.	D
Fair to poor strength; medium compressibility; fair to good resistance to piping.	Moderately slow permeability; 0 to 5 percent slopes.	Drainage not needed.	High available water capacity; slow intake rate; 0 to 5 percent slopes.	Severe: moderately slow permeability.	B

Soil name and location	Parent material	California report No. 65	Depth	Moisture-density 2/		Mechanical analysis 3/	
				Maximum dry density	Optimum moisture	Percentage passing sieve--	
						No. 4 (4.7 mm.)	No. 10 (2.0 mm.)
			Inches	Lb. per cu. ft.	Percent		
Clear Lake clay: NW¼NW¼, sec. 21, T. 5 N., R. 7 W.	Mixed alluvium.	2886	2-8	110	12	-------	100
		2879	60-72	127	8	100	97
Goldridge fine sandy loam: NW¼SW¼, sec. 11, T. 6 N., R. 9 W. (B horizon at 2.0 feet)	Soft sedimentary rock (Merced formation)	2895	0-7	114	10	-------	100
		2885	28-41	113	13	-------	100
		2897	53-72	113	14	-------	-------
Reyes silty clay: SW¼SW¼, sec. 4, T. 4 N., R. 5 W.	Mixed alluvium.	2887	0-7	79	29	100	99
		2883	31-51	87	24	-------	100
Wright loam: NW corner of NW¼SW¼, sec. 31, T. 7 N., R. 8 W.	Old alluvium.	2882	0-7	109	12	100	99
		2888	25-32	111	13	-------	100
		2891	62-73	121	10	-------	100

1/ Tests performed by District IV, California Division of Highways in accordance with procedures given in "California Materials Manual for Testing and Control Procedures."

2/ Based on the method of test for relative compaction of untreated and treated soils and aggregates, test method No. Calif. 216 E.

3/ Results obtained by the mechanical analyses procedure of California Division of Highways (methods 202 and 203) frequently may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the California procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed

TEST DATA 1/

Mechanical analysis 3/--Continued						Liquid limit	Plasticity index	Classification	
Percentage passing sieve--Continued		Percentage smaller than--							
No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO 4/	Unified 5/
98	87	86	67	53	42	50	23	A-7-6(15)	ML or CL
86	34	31	20	15	12	22	5	A-2-4(0)	SM-SC
98	35	30	23	16	9	(6/)	(6/)	A-2-4(0)	SM
99	56	53	45	39	31	30	10	A-4(4)	CL
100	51	49	38	31	22	30	8	A-4(3)	ML-CL
87	72	70	57	42	27	(6/)	(6/)	A-4(7)	ML
99	92	92	80	55	39	68	28	A-7-5(19)	MH, OH
96	66	62	37	17	7	(6/)	(6/)	A-4(6)	ML
97	77	75	58	46	40	49	25	A-7-6(16)	CL
99	48	44	26	18	14	27	6	A-4(3)	SM-SC

by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

4/ Based on AASHO Designation M 145-49 (1).

5/ Based on the Unified Soil Classification System (29). SCS and Bureau of Public roads have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. An example of a borderline classification is ML-CL.

6/ NP=Nonplastic.

anticipated. More information on the range of properties of the soils can be obtained in other parts of this survey, particularly in the section "Descriptions of the Soils."

Depth to bedrock or hardpan, expressed in feet, gives the observed or estimated range of depth from the surface to bedrock.

Depth to seasonal high water table, expressed in feet, gives the observed or estimated range of depth from the surface to the shallowest level reached by a seasonal water table.

The columns headed "Percentage passing sieve" list the estimated range in percentage of material passing sieve numbers 4, 10, 40, and 200. It should not be assumed that all samples of a specific soil will fall within the range of the typical profile shown or that the engineering classification will be the same as shown. The range of estimated physical properties is broad for some of the soils, and as a result the soils may be in several classification groups.

Soil permeability is the ability of a soil to transmit air or water. The rates given in table 6 are for the soils as they occur in place.

The available water capacity, expressed in inches per inch of soil depth, is the capacity of a soil to retain water that can be readily absorbed by plants. It is the estimated amount of water held in a soil between field capacity and the permanent wilting point of plants.

Reaction as shown in table 6 is the estimated range in pH values for each major horizon as determined in the field. It indicates the acidity or alkalinity of the soils. A pH of 7, for example, indicates a neutral soil, a lower pH value, indicates acidity, and a higher value indicates alkalinity.

The shrink-swell potential, rated low, moderate, or high in table 6, is that quality of the soil that indicates the expected volume change with change in moisture content. The volume change behavior of soils is influenced by the amount of moisture change and the amount and kind of clay in the soil. Generally, soils that have high shrink-swell potential present hazards to the maintenance of structures constructed in, on, or with these materials.

The corrosivity ratings of low, moderate, or high indicate the potential damage to uncoated steel structures through chemical action that dissolves or weakens the structural material. Corrosivity correlates closely with the physical, chemical, and biological characteristics of the soil. The soil was evaluated in an undisturbed state. Installations that intersect soil boundaries are more likely to be damaged by corrosion than are installations that are entirely within one kind of soil. Compacting the soil by loading of buildings or otherwise can decrease the permeability of a soil and increase the corrosion potential. Mechanical agitation or excavation that results in mixing of soil horizons may also accelerate corrosivity. The use of corrosivity interpretations without considering the size of the metallic structure or the differential effects involved through use of different metals may lead to the wrong conclusions.

Engineering Interpretations

Table 7 rates the soils according to their suitability as a source of topsoil and road fill. Then, features that affect the suitability of the soils as sites for roads, water retention structures, agricultural drainage, and irrigation systems are given. Also the limitations of the soils for use as septic tank filter fields, and the hydrological soil group are given. Alluvial land, sandy; Alluvial land, clayey; Coastal beaches; Dune land; Riverwash; Rock land; Terrace escarpments; and Tidal marsh are not listed in the table. These land types are too variable in characteristics to be interpreted or otherwise are not suitable for engineering.

Because the interpretations in table 7 are for a typical profile, some variation from the values given should be expected. A description of a typical profile for each series in Sonoma County is in the section "Descriptions of the Soils."

The ratings for soils as a source of topsoil and road fill are good, fair, and poor. The soils are rated as a source of topsoil for use on slopes, shoulders of roads, and along ditches. The ratings are according to suitability of the soils for growth of vegetation.

Estimates of suitability of the soils for use as a source of road fill are based on the AASHO classification and on judgement of the appropriate soil properties.

Road location is influenced by features of the undisturbed soil that affect construction and maintenance of unsurfaced roads. Some of the features that adversely affect the location of roads include slope, shrink-swell potential, depth to hardpan or bedrock, depth to water table, and rock outcrops.

In evaluating the use of the soil for water-retention structures, the soil features affecting both the floor, or reservoir, and the embankment need to be considered. The major soil features affecting the use of soils for constructing embankments are strength, piping, cracking, stability, compressibility, depth to bedrock, and shrink-swell potential. The reservoir area is affected mainly by seepage. The soil features that influence such seepage include permeability, depth to bedrock, depth to water table, and slope.

The use of agricultural drainage is influenced by the need for drainage and the soil features that relate to the effectiveness of a drainage system. Some soil features that affect the installation and performance of surface and subsurface drainage practices are slope, permeability, depth to a restrictive layer or bedrock, and depth to a water table.

Suitability of a soil for irrigation is based chiefly on its available water capacity,

intake rate, depth to bedrock, depth to water table, and slopes. For those soils that are irrigated, the available water capacity is given in general terms. For actual values refer to the section "Descriptions of the Soils."

Ratings used to describe limitations for use of a soil as a septic tank filter field are slight, moderate, or severe. These ratings are based on permeability, slope, depth to bedrock or hardpan, depth to water table, drainage, and hazard of flooding. A filter field is part of the septic soil absorption system for disposal of sewage on the site. It consists of subsurface tile lain in such a way that effluent from the septic tank is distributed with reasonable uniformity into the soil.

Engineers and soil scientists have classified the soil series in the survey area into four hydrologic groups. The grouping is based on estimates of the intake of water during the latter part of a storm of long duration, after the soil profile is wet and has an opportunity to swell, without the protective effect of any vegetation. The grouping is tentative and subject to change as further data and experience are gained. The four groups are:

Group A consists of soils that have a high infiltration rate when thoroughly wetted. These soils have a high rate of water transmission and low runoff potential. They are deep, are well drained or excessively drained, and consist chiefly of sand, gravel, or both.

Group B soils have a moderate infiltration rate when thoroughly wetted. These soils have a moderate rate of water transmission and moderate runoff potential. They are moderately deep or deep, are moderately well drained or well drained, and are medium textured to moderately coarse textured.

Group C soils have a slow infiltration rate when thoroughly wetted. These soils have a slow rate of water transmission and high runoff potential. They have a layer that impedes downward movement of water, or they are moderately fine textured or fine textured, and have a slow infiltration rate.

Group D soils have a very slow infiltration rate when thoroughly wetted. The rate of water transmission is very slow, and runoff potential is very high. In this group are (1) clay soils that have high shrink-swell potential; (2) soils that have a permanent high water table; (3) soils that have a claypan or clay layer at or near the surface; and (4) soils that are shallow over nearly impervious material.

Engineering Test Data

Table 8 shows engineering test data for four soil types that were sampled and tested by the California Division of Highways. The data in the table show classification of the samples under the AASHO and Unified systems, and moisture-density, mechanical analyses, liquid limit, and plasticity index.

In the moisture-density, or compaction test, a sample of the soil material is compacted at successively higher moisture content and the compacted effort remains constant, the dry density of the compacted material increases as the moisture content increases, until the optimum moisture content is reached. After that the density decreases with increase in the moisture content. The highest dry density obtained is termed "maximum density," and the corresponding moisture content is termed "optimum moisture." Moisture-density data are important in construction for as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

Mechanical analyses show the percentage, by weight, or soil particles that would pass sieves of specified sizes. The amount of the clay fraction was determined by the hydrometer method. Sand and coarser particles do not pass through the No. 200 sieve, but silt and clay do.

The tests for liquid limit and plasticity index measure the effect of water on the strength and consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which a soil passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition. When the plastic limit is equal to or higher than the liquid limit, the plasticity index is reported as nonplastic.

FORMATION, CLASSIFICATION, AND MORPHOLOGY OF SOILS[7/]

In this section the factors that have affected the formation of soils in Sonoma County are discussed. Then the current system of classification is explained, the soil series are placed in higher categories of this system, and important processes in the morphology of soils are described.

Formation of Soils

The characteristics of a soil at any given point are determined by the interaction of five factors of soil formation--climate, plants and animals, parent material, relief, and time. Each of these factors affects the formation of every soil, and each modifies the effects of the other four. The importance of the individual factors differs from place to place.

Climate and plants and animals are the active forces of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into soil. Relief modifies the effects of climate and vegetation, mainly by its influence on runoff and temperature. The nature of the parent material also affects the kind of soil that is formed. Time is needed for changing the parent material into soil, and generally, a long time is needed for distinct soil horizons to form.

The interactions among these factors are more complex for some soils than for others. In places, for example, the environment has changed, and the characteristics of a new soil have been superimposed on those of an older soil.

In the pages that follow, the five major factors of soil formation are discussed in relation to their effects on the soils of Sonoma County.

Climate

The climate, or the amount and distribution of heat and moisture received, has a marked influence on the kind of soil that forms. Heat and moisture strongly influence the amount and kind of vegetation, the rate that organic matter decomposes, the rate that minerals weather, and the removal or accumulation of material in the different soil horizons.

Three fairly distinct climatic zones are in the county, although the transition between the zones is gradual. In the coastal climate zone, the average annual temperature is about 53° to 55° F., and the average annual rainfall is 45 to 50 inches. Summer temperatures are cool because of cool winds from the ocean and persistent fog. The evaporation rate is slow. In the interior valleys the average annual temperature is about 57° F. near Sonoma and Petaluma and is nearly 60° at Cloverdale. Summer temperatures are warm. Elevation increases from 10 feet at Petaluma to 340 feet at Cloverdale, and rainfall from 24 inches to about 40 inches. The increase in temperature northward probably is the result of less fog in summer or because of low overcast. In the mountains rainfall is about 50 inches near the coast and 65 or more inches at elevations of 1,500 to 2,000 feet. Average annual temperatures decrease as elevation increases to about 52° F. on the higher ridges where some of the winter precipitation is snow.

Sonoma County has cool to warm, dry summers and cool, moist winters. In summer little rainfall occurs, although along the coast evaporation is slowed and some moisture is released from fog. The rainy season begins about September and reaches a maximum in January. It then decreases until the annual cycle ends about June. Temperatures are highest in July and lowest in January. Detailed climatic data for the county are given in the section "General Nature of the County."

Warm temperatures in spring while the soils are moist are favorable for rapid soil formation. The warm temperatures permit rapid chemical reactions, and water from spring rains moves through the soil to remove dissolved or suspended materials. The remains of plants decompose rapidly and the organic acids that are produced hasten the formation of clay. Soil-forming processes in the county are cyclic. Weathering is relatively rapid in spring and early in summer and slow in fall. Little weathering occurs in winter.

Rainfall is sufficient throughout the county to leach the soils of water soluble materials, and lime occurs only in those soils forming in areas where subdrainage is restricted. Most soils are fairly well leached of bases, and soil reaction generally ranges from slightly acid to strongly acid. Average annual precipitation for most of the county ranges from 30 to 60 inches.

A comparison of Goldridge and Steinbeck soils shows the effect of climate on soil properties. Both of these soils formed in material derived from soft sandstone of the Merced Formation, both are medium acid to very strongly acid, and both are at elevations of 400 to 2,000 feet. Steinbeck soils are where the annual rainfall is about 25 inches, however, and Goldridge soils where annual rainfall is about 40 inches. Also, Steinbeck soils are along the coast in a cool, dry summer climate that is favorable for the accumulation of organic matter, and Goldridge soils are in a warm, dry summer climate. Consequently, Goldridge soils average 1.0 percent organic carbon to a depth of 20 inches, and Steinbeck soils average 1.8 percent organic carbon to this same depth.

Generally, weathering is more rapid in the cool, moist coastal zone than in other zones of the county. Soil forms at intermediate rates in the warmer, drier interior valleys, and at the slowest rates in the colder climates at the higher elevations. Thus,

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[7/] By S. BURKETT JOHNSON, soil specialist, Soil Conservation Service.

climate has had a strong influence on the formation of most soils in the county, but climate alone does not account for all local differences among the soils.

Plants and Animals

Plants, burrowing animals, insects, bacteria, and fungi are important in the formation of soils. Among the changes they cause are gains in organic matter and nitrogen, gains or losses in plant nutrients, and changes in structure and porosity.

Plants generally have a greater affect on soil formation than other organisms. Along the coastal terraces and across the rolling hills to the east, grass is the dominant vegetation. In these areas scattered oaks and shrubs are on hilltops and steep slopes, and redwoods and associated plants are on north slopes and along drainageways. Many grasses from southern Europe have been introduced in these areas, and the European grasses have replaced most of the original perennial grasses (5). Plant growth is similar in the warmer valleys to the east, except that the volume of growth is less and perennial grasses and redwood trees are scarce. The A horizon is thickest and darkest in color in soils in coastal areas, and is thinnest and lightest in color in the warmer valleys. It ranges from less than 1 foot to about 2 feet in thickness.

As rainfall increases in the hills and mountains east of the valleys, the grass-oak-redwood plant association recurs. On the shallow soils, however, this association gives way to shrubs. In the northern mountains near the coast, redwoods are dominant in the canyons and on slopes that face north. At higher elevations outside the persistent fog area, the trees are dominantly Douglas-fir. Organic residue from these plants forms a mat on the surface of the soils that ranges from 1/2 inch to more than 6 inches in thickness. The mat consists of fresh and somewhat decomposed needles, leaves, and twigs and is acid in reaction. The acid reaction of this mat undoubtedly contributes to the reaction of the soils, which generally are also acid. In addition, the roots of these plants follow cracks and fracture planes in the parent rock and assist in the weathering process physically, as well as chemically.

In places roots occupy more than 20 percent of the upper 2 or 3 feet of the soil, particularly that part of the root near the tree. Growth of roots and their decomposition tend to make the soil more porous. The carbon-nitrogen ratio of these soils exceeds 20. In some wooded areas, shrubs are intermingled with coniferous trees. Shrubs generally grow on shallow soils, or they are a transitory cover that follows burning or clearing. Shrubs ultimately disappear after the tree canopy has been reestablished.

Man has directly or indirectly disturbed the soils in the area. He has done this by mining, clearing or burning the vegetation, harvesting timber, grazing livestock, and cultivating the soils. Burning probably has influenced the soils the most, since repeated fires deplete organic matter and change the characteristics of the surface soil. Fires also change the plant ecology. As a result, different plant communities are established, and one of the soil-forming factors is altered. Man and lightning are the main causes of fires.

Parent Material

Parent material is the unconsolidated mass from which a soil forms. It determines the chemical and mineralogical composition of the soil. A wide variety of parent materials are present in Sonoma County, depending largely on the nature of the geological formations.

Early in geologic time, sediment began accumulating under the sea in the area now occupied by Sonoma County. The sediment was derived mostly from a large peninsula off the California coast, which consisted largely of granite or of quartz-diorite. The sediment apparently accumulated in relatively shallow water as the floor of the gulf slowly subsided. At this time submarine volcanic activity was common, and it was especially intense after deposition of the Jurassic Franciscan sediment. As a result of the volcanism, gabbro, diabase, and peridotite intruded the Franciscan rocks, and outpourings of basalt occurred (31).

Following the period of volcanism, the land surface was at sea level or slightly above it for a long period. At this time thick beds of silt and clay were deposited as the general land area slowly subsided. Surface relief was fairly gentle, and the presence of clay beds resulted in the formation of the Cretaceous Knoxville shales. Subsequently, the marine sandstone of the Petaluma and Merced Formations were laid down in shallow water, and a crustal disturbance late in the Pliocene epoch uplifted the land surface to form the Mendocino plateau. This surface warped downward toward the south, and a zone of weakness developed in the southeastern part of the county where the Sonoma Volcanics extruded (10). During the Pleistocene epoch and later, similar uplift and deformation continued and formed the present landscape.

In late Pleistocene time subsidence occurred near the southern part of the county and allowed the sea to enter the coastal valleys. The valleys slowly filled with alluvial sediment until only the San Francisco Bay remained. One of the most striking features of the present landscape is the San Andreas Rift, a fault that traverses the western edge of the county. Intermittent movement along this and other faults indicates that crustal deformation continues. Many faults occur in the area. Abrupt changes in landscape and kinds of rock are likely to be associated with these faults.

In a large part of the area the landscape is dominated by sandstone and shale, but these rocks differ greatly in age, hardness, and resistance to weathering. These differences in rocks cause

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differences in landscape, and they affect the characteristics of the soils that form.

Near the Mendocino Plateau in the northern part of Sonoma County are Franciscan and Knoxville sandstones, shales, conglomerates, and associated volcanic rocks. The sedimentary rocks are firmly cemented, and they are more or less metamorphosed (10). The ridges generally range from 1,500 to 3,000 feet in elevation, and slopes into canyons are steep in this area. Because of slow weathering of the rocks, the soils are gravelly and shallow. The Hugo, Josephine, and Laughlin soils are extensive in this area. In addition to these soils that formed in material from sedimentary rocks, scattered areas of very different soils formed in material weathered from diabase and serpentine. Examples are soils of the Henneke, Huse, and Montara series. These soils are less fertile than soils derived from sedimentary rocks because ultrabasic rocks contain large amounts of magnesium relative to calcium. Excess magnesium in soils seriously reduces the uptake of calcium by plants (30). Soils, such as those in the Cohasset and Red Hill series that formed in material derived from basalt and gabbro, are adequately supplied with calcium, and they are relatively fertile. Cohasset and Red Hill soils are more fertile than soils that formed in material weathered from Franciscan sandstone and shale because sandstone and shale are largely silica and are relatively low in weatherable minerals. Also in this general area are Yorkville soils that formed in material derived from glaucophane schist and from similar rocks of the Franciscan Formation.

The rounded hills of the Merced Formation are in the southern part of Sonoma County. They are west of Sebastopol, and they extend from Forestville to Petaluma. The rocks of this formation consist mostly of massive, weakly cemented, fine-grained sandstone that contains fossils. In places the sandstone contains tuff and is fairly strongly cemented (24). Here the sandstone forms rocky knobs and low cliffs. Small scattered areas of sandstone occur as far north as the northern boundary of Sonoma County. Soils that formed in material derived from rocks of this formation are in the Cotati, Goldridge, Sebastopol, and Steinbeck series.

East of the Merced Formation and separating the Cotati and Petaluma Valley from the Sonoma Valley are the Sonoma Volcanics. This formation is a complex series of lava flows and tuff beds that in places are interbedded with sandstone, gravel, and conglomerate (31). The tuff beds dominate the formation, and where these beds are thick they have weathered to rounded, gently sloping to steep hills. In places where the sandstone or tuff is strongly cemented and is more resistant to weathering, slopes are short, very steep, and rocky. Soils that formed in material derived from Sonoma Volcanics include those of the Laniger series in areas where the material is more deeply weathered. Other soils are the gently sloping to moderately sloping Tuscan that formed in material derived from tuffaceous conglomerates, and the Felta and Spreckels soils on dissected terraces and low hills. Such soils as those in the Huichica series, which occur in and along the margins of the Santa Rosa and Sonoma Valleys formed in alluvium washed from Sonoma Volcanics.

Along the margins of interior valleys are younger terraces and fanglomerates of Pleistocene age (10, 24). The soils here generally are gravelly or cobbly if they are close to the mountains, and especially if they are below such a gravel source as shale. The soils that form in material from these formations depend in part on the mineralogical nature of the deposits. For example, Manzanita and Los Robles soils formed in areas dominated by alluvium from such volcanic rocks as basalt, andesite, and gabbro. On the other hand such soils as those in the Clough, Haire, Huichica, and Wright series formed in terrace alluvium that has mixed mineralogy.

Below the terraces are the youngest geologic formations in the county. These are the deposits of recent alluvium. Soils that formed in this recent sediment have a few characteristics that are influenced by mineralogy, but generally texture and thickness of the soils are more important than the mineralogy. Examples of soils that formed in recent alluvium are those of the Arbuckle, Clear Lake, Cole, Cortina, Pajaro, Pleasanton, Reyes, Yolo, and Zamora series.

Relief

Relief, or the shape of the landscape, affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. In Sonoma County the soils range from nearly level to very steep.

The Clear Lake, Reyes, and other poorly drained soils formed in nearly level and depressional areas where water stands or drains away slowly. In such places the soils are saturated for long periods and are poorly aerated. This causes reduction and transfer of iron and formation of gray colors.

In rolling areas where drainage is good, the soils generally are well aerated and have red, yellow, or brown colors. On steep slopes in the mountains, and in similar areas, erosion removes the soil material nearly as fast as it forms. Consequently, a thick soil profile never forms, and the soils are shallow over rock. Maymen soils are examples.

The Maymen soils and soils of the Hugo, Josephine, and Sites series formed in material derived from similar rock. They illustrate a sequence in soil development as related to relief and erosion. Maymen soils, on narrow ridge crests or adjacent steep slopes, are shallow or very shallow to rock. Hugo soils, on the other hand, are on broad divides, are more gently sloping and less erodible, and are on side slopes. They have a weakly developed B horizon and are moderately deep. Josephine soils, on long stable slopes or low gently sloping divides, have a distinct, reddish B horizon and are moderately deep

to deep. Sites soils occupy the most stable position in the landscape. They have a B horizon of yellowish-red clay. Some differences among these soils, however, could be related to the weatherability of the parent rock.

Time

A long period of time generally is required for soils to form. For this reason, the differences in the length of time that parent materials have been in place are commonly reflected in the character of the soil.

The soils in Sonoma County range from young to old. The young soils have little or no profile development, but the old soils have a profile that is well defined.

The Cortina, Arbuckle, and Haire soils are examples of soils that owe their differences in characteristics mostly to differences in time. The Cortina soils are young and lack developed horizons because the materials have been in place only a short time. The Arbuckle soils are a few feet higher than the Cortina soils, and they have been in place long enough for weakly expressed horizons to develop. The B horizon in Arbuckle soils contains slightly more clay than the A horizon. Furthermore, the carbonates have leached out of these soils and they are slightly acid. The Haire soils, on undulating terraces, are well developed and are considered to be old. They have a strongly acid, clay B horizon.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (3) and later revised (23). The system currently used was adopted for general use by the National Cooperative soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of this system should search the latest literature available (20, 28). The soil series of Sonoma County are placed in some categories of the current system in table 9.

TABLE 9.--SOIL SERIES CLASSIFIED ACCORDING TO THE CURRENT SYSTEM OF CLASSIFICATION

Series 1/	Family	Subgroup	Order
Arbuckle	Fine-loamy, mixed, thermic	Mollic Haploxeralfs	Alfisols.
Atwell	Fine, vermiculitic, mesic	Typic Hapludalfs	Alfisols.
Baywood	Sandy, mixed, mesic	Pachic Haploxerolls	Mollisols.
Blucher	Coarse-loamy over clayey, mixed, noncalcareous, mesic.	Typic Haplaquolls	Mollisols.
Boomer	Fine-loamy, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Caspar	Fine-loamy, mixed, isomesic	Typic Tropudults	Ultisols.
Cibo	Fine, montmorillonitic, thermic	Typic Chromoxererts	Vertisols.
Clear Lake	Fine, montmorillonitic, thermic	Typic Pelloxererts	Vertisols.
Clough	Clayey-skeletal, kaolinitic, thermic	Abruptic Durixeralfs	Alfisols.
Cohasset	Fine-loamy, mixed, mesic	Xeric Haplohumults	Ultisols.
Cole	Fine, mixed, thermic	Pachic Argixerolls	Mollisols.
Comptche	Fine-loamy, mixed, mesic	Ultic Haploxerolls	Mollisols.
Cortina	Loamy-skeletal, mixed, nonacid, thermic	Typic Xerofluvents	Entisols.
Cotati	Clayey, montmorillonitic, mesic	Typic Haploxerults	Ultisols.
Diablo	Fine, montmorillonitic, thermic	Chromic Pelloxererts	Vertisols.
Dibble	Fine, montmorillonitic, thermic	Typic Haploxeralfs	Alfisols.
Empire	Fine-loamy, mixed, isomesic	Typic Tropohumults	Ultisols.
Felta	Cindery, thermic	Typic Argixerolls	Mollisols.
Forward	Ashy, mesic	Typic Vitrandepts	Inceptisols.
Goldridge	Fine-loamy, mixed, mesic	Typic Hapludults	Ultisols.
Goulding	Loamy-skeletal, mixed, mesic	Lithic Xerochrepts	Inceptisols.
Guenoc	Fine, kaolinitic, thermic	Typic Rhodoxeralfs	Alfisols.
Haire	Fine, montmorillonitic, thermic	Abruptic Palexerolls	Mollisols.
Hely	Fine-loamy, mixed, isomesic	Typic Humitropepts	Inceptisols.

TABLE 9.--SOIL SERIES CLASSIFIED ACCORDING TO THE CURRENT SYSTEM OF CLASSIFICATION--Continued

Series 1/	Family	Subgroup	Order
Henneke	Clayey-skeletal, serpentinitic, thermic	Lithic Argixerolls	Mollisols.
Hugo	Fine-loamy, mixed, mesic	Dystric Xerochrepts	Inceptisols.
Huichica	Fine, montmorillonitic, thermic	Abruptic, Haplic, Durixeralfs.	Alfisols.
Huse	Clayey, mixed, mesic	Lithic Xerochrepts	Inceptisols.
Josephine	Fine-loamy, mixed, mesic	Typic Haploxerults	Ultisols.
Kidd	Ashy, mesic	Lithic Vitrandepts	Inceptisols.
Kinman	Fine, montmorillonitic, isomesic	Aquic Argiudolls	Mollisols.
Kneeland	Fine-loamy, mixed, isomesic	Typic Haploxerolls	Mollisols.
Kneeland, sandy variant.	Sandy, mixed, isomesic	Typic Dystrochrepts	Inceptisols.
Laniger	Ashy, thermic	Typic Vitrandepts	Inceptisols.
Laughlin	Fine-loamy, mixed, mesic	Typic Xerochrepts	Inceptisols.
Los Gatos	Fine-loamy, mixed, mesic	Typic Argixerolls	Mollisols.
Los Osos	Fine, montmorillonitic, thermic	Typic Argixerolls	Mollisols.
Los Robles	Fine-loamy, mixed, thermic	Mollic Haploxeralfs	Alfisols.
Manzanita	Fine, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Maymen	Loamy, mixed, mesic	Dystric Lithic Xerochrepts.	Inceptisols.
Mendocino	Clayey, illitic, isomesic	Typic Tropohumults	Ultisols.
Montara	Loamy, serpentinitic, thermic	Lithic Haploxerolls	Mollisols.
Noyo	Fine-loamy, mixed, isomesic	Aeric Umbric Tropaquults.	Ultisols.
Pajaro	Coarse-loamy, mixed noncalcareous, mesic	Typic Haplaquolls	Mollisols.
Pleasanton	Fine-loamy, mixed, thermic	Mollic Haploxeralfs	Alfisols.
Positas	Fine, montmorillonitic, thermic	Mollic Palexeralfs	Alfisols.
Raynor	Fine, montmorillonitic, thermic	Chromic Entic Pelloxererts.	Vertisols.
Red Hill	Fine, mixed, mesic	Ultic Palexerolls	Mollisols.
Reyes	Fine, mixed, sulfurous, acid, thermic	Fluventic Haplaquepts	Inceptisols.
Rohnerville	Clayey, mixed, isomesic	Typic Tropohumults	Ultisols.
Sebastopol	Clayey, mixed, mesic	Typic Haploxerults	Ultisols.
Sheridan	Coarse-loamy, mixed, mesic	Pachic Haploxerolls	Mollisols.
Sites	Clayey, kaolinitic, mesic	Xeric Haplohumults	Ultisols.
Sobrante	Fine-loamy, mixed, thermic	Mollic Haploxeralfs	Alfisols.
Spreckels	Fine, mixed, thermic	Ultic Palexeralfs	Alfisols.
Steinbeck	Fine-loamy, mixed, mesic	Mollic Haploxeralfs	Alfisols.
Stonyford	Loamy, mixed, thermic	Lithic Mollic Haploxeralfs.	Alfisols.
Supan	Fine-loamy, mixed, mesic	Pachic Argixerolls	Mollisols.
Suther	Fine, mixed, mesic	Aquic Haploxeralfs	Alfisols.
Toomes	Loamy-skeletal, mixed, nonacid, thermic	Lithic Xerorthents	Entisols.
Tuscan	Fine, montmorillonitic, thermic	Typic Durixeralfs	Alfisols.
Wright	Fine, mixed, mesic	Typic Albaqualfs	Alfisols.
Yolo	Fine-silty, mixed, nonacid, thermic	Typic Xerorthents	Entisols.
Yorkville	Fine, chloritic, mesic	Pachic Argixerolls	Mollisols.
Zamora	Fine-silty, mixed, thermic	Mollic Haploxeralfs	Alfisols.

1/ Placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

2/ Arbuckle soils in Sonoma County have a darker color and contain more organic matter than is typical for the series elsewhere in California.

3/ Atwell soils in Sonoma County contain less organic matter and are paler in color than is typical for the series elsewhere in California.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar origin are grouped together. The classes of the current system are briefly defined in the paragraphs that follow.

ORDERS: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. The six orders in Sonoma County are Alfisols, Entisols, Inceptisols, Mollisols, Ultisols, and Vertisols.

Alfisols formed mostly under trees. They are light colored and have a base saturation of more than 35 percent. The base saturation increases with increasing depth.

Entisols are young mineral soils that do not have genetic horizons or have only the beginning of such horizons.

Inceptisols are mineral soils in which horizons have definitely started to develop. They generally are on young, but not recent, land surfaces.

Mollisols have formed mostly under grass. They have a thick, friable, dark-colored surface layer. Base saturation is more than 50 percent.

Ultisols are soils that have a clay-enriched B horizon that has less than 35 percent base saturation. The base saturation decreases with depth.

Vertisols are clayey soils that crack, shrink, and swell in all seasons and that have wide deep cracks during dry periods.

SURBORDERS. Each order is subdivided into suborders, primarily on the basis of soil characteristics that seem to produce classes having the greatest genetic similarity. The suborders have a narrower climatic range than the orders. The criteria for suborders chiefly reflect the presence or absence of waterlogging or soil differences resulting from climate or vegetation.

GREAT GROUPS: Each suborder is divided into great groups according to the presence or absence of genetic horizons and the arrangement of these horizons.

SUBGROUPS: Each great group is subdivided into subgroups. One of these subgroups represents the central (typic) segment of the great group, and the others, called intergrades, contain those soils having properties of soils in another group, suborder, or order.

FAMILIES: Each subgroup is divided into families, primarily on the basis of properties important to the growth of plants. Among the properties considered are texture, mineralogy, reaction, soil temperature, and thickness of horizons.

SERIES: The series consists of a group of soils that formed from a particular kind of parent material and having genetic horizons that, except for texture of the surface soils, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, consistence, reaction, and mineralogical and chemical composition.

Morphology of Soils

Several processes have been involved in the formation of soil horizons in the soils of Sonoma County. The differentiation of horizons in soils in this county is the result of one or more of the following processes: (1) Accumulation of organic matter, (2) leaching of calcium carbonates and bases, (3) reduction and transfer of iron, and (4) formation and translocation of silicate clay minerals.

The accumulation of organic matter in the upper part of the profile to form an A1 horizon has been an important process of horizon development. The soils of Sonoma County range from medium to very low in organic-matter content. Leaching of carbonates and bases has occurred in nearly all the soils in the county. Many of the soils are moderately to strongly leached.

The reduction and transfer of iron, a process called gleying, is evident in the poorly drained soils of the county. The gray color in the B and C horizons indicates the reduction and loss of iron. Some horizons contain reddish-brown mottles and concretions, which indicates segregation of iron.

In many of the soils the translocation of clay minerals has contributed greatly to horizon development. In such soils the eluviated A horizon above the B horizon is lower in content of clay and is lighter in color. The B horizon has an accumulation of clay and has clay films in pores and on ped surfaces. Considerable leaching of carbonates and soluble salts probably took place in these soils before the translocation of silicate clays. Leaching of bases and translocation of silicate clays are among the most important processes in horizon differentiation in the soils of Sonoma County.

The results of the physical and chemical analyses of representative soils of the county are given in table 10. The data are for selected soils of 6 soil series that are extensive in the county, and they are based on the profile that is described as representative of the series in the section "Descriptions of the Soils." The samples were analyzed by the Soil Survey Laboratory, Soil Conservation Service, Riverside, Calif.

The soil samples were air dried and crushed by hand so that the material would pass through a 2-millimeter, round-hole sieve. The gravel and stones larger than 2-millimeters in diameter were reported as a weight percentage of the total sample. Most determinations, except those for bulk density, were made on the soil material smaller than 2 millimeters in diameter. All results are expressed on an oven-dry basis. Methods that were used in obtaining the data are described in the paragraphs that follow.

Size class and diameter of particles.--Separation of particles into size classes and ranges of diameters for particle-size distribution data were made by pipette and by sieve analyses. After treatment of the sample to remove organic matter and soluble salts, particles were dispersed with sodium hexametaphosphate and mechanical shaking (13, 14).

Bulk density.--Bulk density, expressed in grams per cubic centimeter, was determined on core samples (25). The samples were taken with a modified Uhland sampler and a core retainer 4.7 centimeters in diameter and 3.5 centimeters in depth. The bulk density is presumed to be equal to the horizon density at field moisture.

Moisture retention.--Water held at a tension of 15 atmospheres was determined by using the pressure membrane apparatus on the fragmented samples (19). Moisture retained at 15 atmospheres pressure corresponds fairly closely to the permanent wilting point.

Percent organic carbon.--The percent of organic carbon was determined by acid-dichromate digestion and ferrous sulfate titration, a modification of the Walkley-Black method (18).

Percent total nitrogen.--The toal nitrogen was determined by Kjeldahl analysis, a modification of the method described by the Association of Official Agricultural Chemists (2).

Extractable iron.--The soil sample was treated with sodium dithionate to reduce and extract the iron. The extracted iron was titrated with ethylenediaminetetraacetate (EDTA), and the amount thus determined was calculated and reported as percent ferric oxide (12, 7).

Reaction.--Soil reation, expressed in pH value, was obtained by a glass electrode and using a 1:1 soil-water ratio and a 1:1 soil and potassium chloride salt solution (18, 19).

Electrical conductivity.--Electrical conductivity as an estimate of soluble salts in the saturation extract was measured by Wheatstone bridge. The conductivity is reported in millimhos per centimeter at the standard temperature of 25° C. (19).

Extractable cations.--Calcium, magnesium, sodium, and potassium were extracted with neutral, normal ammonium acetate (18). Calcium was precipitated as an oxalate and titrated with permanganate (18), magnesium was determined gravimetrically as magnesium pyrophosphate (2), and sodium and potassium were analyzed by flame photometer (9). Exchange acidity or exchangeable hydrogen was displaced from the soil with triethanolamine and barium chloride at pH 8.2 (18). Exchangeable sodium and potassium as given is corrected data calculated by subtracting the amount of sodium and potassium in the saturation extract from the amount extracted with ammonium acetate.

Cation-exchange capacity.--The cation-exchange capacity was determined after the sample had been sodium saturated by mixing it with a solution of sodium acetate. The amount of exchangeable sodium that was later extracted by ammonium acetate represents the cation-exchange capacity (19).

Ions in the saturation extract.--The ions in the saturation extract, expressed as milliequivalents per liter, were determined by analyzing the water extracted from a saturated soil paste. The water was removed by vacuum filtration and the soluble ions were determined by the following procedures: sodium and potassium by flame photometry; calcium and magnesium by titration with versenate (19); and chloride by titration with silver nitrate (19).

Exchangeable sodium percentage.--The exchangeable sodium percentage given for Clear Lake clay is a value derived by dividing the exchangeable sodium by the cation-exchange capacity and multiplying the result by one hundred (19).

TABLE 10.--PHYSICAL AND CHEMICAL

[Analyses were made at the Soil Survey Laboratory, Soil Conservation Service, Riverside, Calif. A dash

Soil name and sample number	Depth from surface	Size class and diameter of particles							Bulk density	Moisture retension at 15 atmospheres	Organic carbon	Total nitrogen
		Very coarse sand (2.0-1.0 mm.)	Coarse sand (1.0-0.5 mm.)	Medium sand (0.5 0.25 mm.)	Fine sand (0.25-0.10 mm.)	Very fine sand (0.10-0.05 mm.)	Silt (0.05-0.002 mm.)	Clay (<0.002 mm.)				
	In.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Gm./cc.	Pct.	Pct.	Pct.
Clear Lake clay (S61 Calif-49-10):	0-2	0.1	0.7	1.8	8.6	5.3	34.3	49.2	-----	20.6	1.02	0.079
	2-8	.1	.9	1.8	8.0	5.4	34.2	49.6	-----	21.9	.98	.086
	8-25	.2	.7	1.9	8.5	5.3	33.6	49.8	-----	21.9	.80	.060
	25-39	.1	.7	1.7	8.3	5.8	33.4	50.0	-----	25.3	.79	.052
	39-46	.1	.7	1.6	8.2	5.8	34.7	48.9	-----	25.6	.50	.030
	46-52	.3	.8	2.5	10.1	7.5	34.5	44.3	-----	22.3	.24	-----
	52-60	.7	2.2	6.9	23.8	10.2	27.8	28.4	-----	14.8	.07	-----
	60-72	1.8	5.8	16.4	36.8	9.6	15.3	14.3	-----	6.9	.04	-----
Goldridge fine sandy loam (S61 Calif-49-6):	0-7	.2	.7	1.1	49.0	18.6	20.9	9.5	-----	4.2	1.48	.109
	7-20	.1	.4	.6	46.4	19.3	21.0	12.2	1.43	4.7	.52	.048
	20-24	0	.3	.5	46.5	18.9	21.3	12.5	1.56	4.5	.20	.023
	24-28	.1	.3	.4	43.9	16.5	20.9	17.9	1.60	6.5	.18	.024
	28-41	0	.2	.4	37.8	11.1	17.1	33.4	1.65	14.0	.20	.030
	41-57	0	0	.2	38.5	12.9	19.5	28.9	1.60	13.5	.06	-----
	57-73	0	.2	.2	38.3	16.6	23.1	21.6	1.52	11.8	.03	-----
Huichica loam (S61 Calif-49-7):	0-7	1.8	5.7	6.1	20.7	14.7	41.7	9.3	1.53	5.0	1.10	.096
	7-14	1.6	5.5	5.9	19.3	14.6	42.3	10.8	1.50	5.1	.26	.047
	14-23	2.4	5.3	6.1	18.9	15.8	40.1	11.4	-----	5.7	.17	.040
	23-30	6.5	8.0	7.0	15.5	7.7	26.1	29.2	-----	13.6	.14	-----
Reyes silty clay (S61 Calif-49-13):	0-7	.1	.3	.2	.5	.3	39.7	58.9	-----	26.0	5.01	.427
	7-14	.1	.3	.1	.5	.4	37.9	60.7	-----	28.2	5.04	.421
	14-22	0	.1	.1	.3	.3	40.2	59.0	-----	31.4	2.63	.225
	22-31	0	.2	.1	.3	.2	38.5	60.7	-----	32.2	2.29	.208
	31-51	0	.1	.1	.3	.2	41.2	58.1	-----	34.8	1.96	.197
	51-63	.1	.3	.1	.4	.2	36.0	62.9	-----	41.5	5.48	.368
Steinbeck loam (S61 Calif-49-4):	0-8	.4	.7	.6	10.4	35.2	36.5	16.2	1.42	7.8	2.21	.173
	8-18	.4	.6	.4	9.4	35.1	36.1	18.0	1.43	7.9	1.47	.128
	18-28	.3	.5	.3	10.5	36.6	37.4	14.4	1.54	6.2	.82	.071
	28-35	.3	.5	.3	12.0	38.7	38.9	9.3	1.55	4.2	.29	.039
	35-45	.3	.4	.3	9.4	35.5	33.7	20.4	1.71	9.4	.18	----
	45-56	.1	.4	.3	8.8	32.3	34.2	23.9	1.67	11.6	.14	----
	56-68	0	.1	.3	19.3	38.5	33.8	8.0	-----	10.1	.02	----
Wright loam (S61 Calif-49-2):	0-7	.6	1.8	4.5	20.9	14.1	46.4	11.7	1.54	7.6	2.73	.188
	7-15	.6	1.9	4.4	20.6	14.6	46.1	11.8	1.51	5.2	.48	.050
	15-25	.3	1.8	4.4	20.2	14.8	44.8	13.7	1.70	6.2	.16	.023
	25-32	.4	1.4	3.5	13.2	8.5	31.1	41.9	1.76	20.9	.19	.023
	32-42	.3	1.6	3.0	11.9	9.2	33.3	40.7	1.70	20.8	.13	----
	42-47	.1	.8	3.3	13.8	12.7	39.8	29.5	1.62	18.8	.06	----
	47-62	.1	.6	2.8	26.8	17.8	30.4	21.5	1.73	14.7	.02	----
	62-72	.1	.6	5.5	38.8	15.8	22.8	16.4	1.72	11.1	.03	----

1/ A soil-water dilution of 1:10 was used to determine pH.

2/ Exchangeable potassium, corrected data.

indicates that the determination was not made or that less than the minimum reportable amount was detected]

Extractable iron as Fe_2O_3	Reaction (1:1) H$_2$O	Reaction (1:1) KCl	Electrical conductivity	Extractable cations (meq. per 100 grams of soil) Ca	Mg	Na	K	H	Base saturation	Cation exchange capacity (NaOAc)	Soluble ions in saturation extract (milliequivalents per liter) Na	K	Ca	Mg	Cl
Pct.	pH	pH	Mmhos./100 cm.						Pct.	Meq./100 gms.					
0.6	5.6	[1]6.6	0.4	21.9	19.4	[2]0.4	[3]0.3	7.4	[4] 1	50.0	1.2	0.1	1.2	1.4	1.5
.5	5.3	[1]6.7	.2	21.5	19.3	[2] .5	[3] .2	7.2	[4] 1	51.0	.9	([5])	.4	.8	.3
.6	5.5	[1]6.9	.2	21.7	20.2	[2]1.2	[3] .2	6.0	[4] 2	51.4	1.5	([5])	.4	.5	.4
.5	6.5	[1]7.5	.8	22.6	21.4	[2]2.0	[3] .2	3.1	[4] 4	51.5	4.5	([5])	1.2	1.3	3.9
.4	7.4	[1]8.1	2.1	22.8	22.7	[2]2.3	[3] .3	1.2	[4] 5	50.3	10.4	.1	4.1	5.4	15.1
.4	7.7	[1]8.4	2.7	([6])	([6])	[2]2.1	[3] .3	---	[4] 7	41.9	12.0	.1	5.4	6.6	20.7
.3	7.8	[1]8.7	2.5	([6])	([6])	[2]2.4	[3] .3	---	[4]11	28.6	11.1	.1	4.9	5.8	19.2
.4	7.5	[1]7.4	1.5	([6])	([6])	[2] .9	[3] .2	---	[4] 6	15.5	8.0	.1	1.8	2.6	11.1
.4	5.0	4.3	---	2.0	.5	.2	.6	6.8	33	9.8	----	----	----	----	----
.4	5.2	4.0	---	1.3	.3	.1	.3	5.2	29	7.4	----	----	----	----	----
.4	5.1	4.0	---	1.3	.5	.1	.2	3.5	38	5.7	----	----	----	----	----
.6	5.0	3.9	---	1.7	.9	.1	.2	3.4	46	7.3	----	----	----	----	----
1.4	4.6	3.7	---	2.2	1.9	.2	.2	9.6	30	.7	----	----	----	----	----
1.2	4.5	3.6	---	.9	2.1	.2	.1	10.2	25	13.5	----	----	----	----	----
1.0	4.5	3.6	---	.7	1.8	.2	.1	10.0	21	12.8	----	----	----	----	----
.6	5.4	4.2	---	2.5	.8	.1	.3	5.7	40	10.0	-----	----	----	----	----
.6	5.5	4.0	---	2.4	1.5	.2	.3	4.4	49	8.8	-----	-----	----	----	----
.6	6.1	4.3	---	2.6	2.3	.3	.2	3.2	63	9.1	-----	----	----	----	----
.6	6.7	5.0	---	7.6	9.1	1.2	.2	3.2	76	22.1	-----	----	----	----	----
1.7	4.2	3.3	.8	3.9	7.6	38.1	.4	38.1	----	49.6	2.7	.5	1.0	3.1	4.3
1.5	4.1	3.2	.8	3.8	7.8	38.4	.4	38.4	----	51.1	3.0	.4	1.2	3.0	4.1
1.4	3.7	3.1	2.8	3.5	8.9	35.4	1.3	35.4	----	46.4	12.5	.9	2.7	9.2	18.2
1.8	3.7	3.1	4.3	3.3	9.3	35.4	1.8	35.4	----	43.6	58.5	1.1	4.7	17.3	29.4
1.2	3.6	3.2	9.5	3.8	12.0	31.2	3.0	31.2	----	42.2	56.3	1.8	8.1	37.6	55.6
.6	3.6	3.4	23.7	9.9	27.7	31.1	3.2	33.1	----	51.9	213.0	7.3	25.8	184.2	182.0
1.0	5.4	4.2	---	3.9	2.4	.3	.9	12.0	38	17.7	----	----	----	----	----
1.0	5.5	4.2	---	3.6	2.5	.3	.2	11.2	37	17.0	----	----	----	----	----
.9	5.8	4.2	---	3.1	2.7	.3	.1	7.7	44	13.4	----	----	----	----	----
.7	5.9	4.2	---	2.5	2.4	.2	.1	4.6	53	9.6	----	----	----	----	----
1.3	5.8	4.1	---	5.0	6.1	.4	.1	5.0	70	17.1	----	----	----	----	----
1.5	5.7	4.1	---	7.1	8.3	.5	.2	4.9	77	21.2	----	----	----	----	----
1.6	5.9	4.2	---	8.7	9.6	.5	.2	3.7	84	23.3	----	----	----	----	----
.6	6.0	5.1	---	2.0	1.7	.2	.5	6.1	63	15.5	----	----	----	----	----
.6	6.2	5.0	---	4.9	1.7	.1	.3	3.5	66	11.7	----	----	----	----	----
.7	5.8	4.3	---	4.6	3.0	.2	.2	3.5	69	11.9	----	----	----	----	----
.5	5.4	3.4	---	15.0	14.2	.5	.4	9.5	76	44.1	----	----	----	----	----
.6	5.3	3.9	---	20.2	19.0	.7	.5	9.4	81	45.2	----	----	----	----	----
.9	6.5	4.8	---	20.1	17.7	.8	.4	2.7	94	42.7	----	----	----	----	----
1.1	6.7	4.9	---	16.6	14.5	.7	.4	2.6	93	33.8	----	----	----	----	----
1.1	6.5	4.5	---	13.4	11.9	.5	.9	2.8	91	30.1	----	----	----	----	----

[3] Exchangeable sodium, corrected data.

[4] Exchangeable sodium percentage.

[5] Trace.

[6] Calcareous.

This section provides information about the relief and drainage and the climate of Sonoma County.

Relief and Drainage

Sonoma County is divided into about equal parts of level valley land at elevations of sea level to 300 feet; rolling hills that range from 300 to 1,000 feet; and fairly rugged small mountains that rise to an elevation of about 4,000 feet. The highest point in the county is the peak of Mt. St. Helena, which is 4,344 feet above sea level.

The valleys generally are in the east-central part of the county and extend in a northwestern to southeastern direction. The Dry Creek and Sonoma Valleys are two major arms of a larger central valley and plains area. The Dry Creek Valley meets the Russian River Valley south of Healdsburg. The Sonoma Valley is southeast of Santa Rosa, and it is separated from the central valley and plains area by a range of hills near Sonoma. Rolling hills surround the valleys. These hills are mainly in a large area in the southwestern part of the county.

The northwestern quarter of the county between the Pacific Ocean and the Russian River Valley is mountainous. Also, mountains generally extend along the eastern boundary of the county, from the Mendocino County line to about 6 miles north of the San Pablo Bay.

Sonoma County is drained by five major streams and their tributaries. The Russian River is the largest of these streams. This river flows southeastward past Cloverdale, Geyserville, and Healdsburg, then turns westward and eventually enters the Pacific Ocean at Jenner. Dry Creek, the next largest stream, drains a large hilly area west of Cloverdale, and then flows southeastward toward Healdsburg. It joins the Russian River just south of Healdsburg. Santa Rosa Creek and its tributaries drain about 50,000 acres east and south of Santa Rosa. This creek flows westward through the town of Santa Rosa, across the central Sonoma plain area, and then empties into the Laguna de Santa Rosa northeast of Sebastopol. The slow-moving Laguna receives water from the outlets of several other smaller creeks and then moves northward to join the Russian River near Trenton.

Runoff water from the two remaining main drainage areas empties into the north end of San Pablo Bay. Water from the watershed area of the ranges on both sides of Sonoma Valley flows southward, past the town of Sonoma, and into the tidal flat area adjoining San Pablo Bay. The Petaluma River receives the water flowing out from the hills surrounding Petaluma, and then it empties into sloughs in the tidal flats between Petaluma and the San Pablo Bay.

Climate[8/]

The climate of Sonoma County is characterized by moderate temperature and precipitation (8).

8/ By C. ROBERT ELFORD, climatologist for California, National Weather Service, U.S. Department of Commerce.

Temperatures along the coast remain cool throughout the summer, and they seldom drop below freezing in winter. Inland the range in temperature is wider. Here the temperature occasionally exceeds 100° F., and it sometimes falls as low as several degrees below freezing. Night temperatures generally drop into the lower 50's, even during the warm period of the year.

Most of the precipitation comes within the 6 colder months of the year, and only light amounts are reported during the rest of the year. Annual rainfall generally increases as elevation increases, and it is greatest in the northern part of the county. Along the coast low clouds and drizzle at night during summer provide enough moisture to keep pastures green. Inland, however, the summer dry period is long enough to deplete stored moisture in the soil and stop the growth of plants.

Winds are fairly light most of the time, though they blow rather persistently in summer, particularly in coastal areas. Sunshine is abundant in summer throughout most of the county, except for considerable cloudiness along the coast.

In summer Sonoma County is protected from the hot weather of the Central Valley of California by the coast range of mountains east of the Russian River. Areas at a low elevation in the county receive enough sunshine to warm up considerably in summer without receiving any hot air from the interior. The Pacific Ocean, however, provides a source of cool, moist air in summer, and this steady flow of marine air holds temperatures in its path at a moderate level. The warmest part of the county generally is the Russian River Valley near the north end of the county, where mountains deflect the cool air and diminish its effect.

Temperature and precipitation information representative of coastal areas and of inland areas are provided in table 11. The data in the table was compiled from records at two weather stations of the National Weather Service in Sonoma County. The station at Fort Ross is along the coast, and that at Santa Rosa is inland.

Temperature.--The temperature of the sea water off the coast markedly influences the pattern of temperature in the county. On the average, temperatures of the sea water range from about 53° in winter to 55° late in summer and in fall. Because of these cool water temperatures, air temperatures in the county remain cool in summer, particularly at night. Also, as a result of the water temperatures, the warmest part of the year is late in summer or in fall. This temperature pattern is most pronounced near the coast. Minimum temperatures during the warm season are below 50° in most places and are less than 54°, even near Cloverdale in the northern part of the county.

The greatest variation in temperature occurs in summer. The average daily maximum temperature is 64° along the extreme northern part of the coast in

TABLE 11.--TEMPERATURE AND PRECIPITATION FOR TWO WEATHER STATIONS IN SONOMA COUNTY

Fort Ross, Calif.

Month	Temperature: Highest	Temperature: Average maximum	Temperature: Average	Temperature: Average minimum	Temperature: Lowest	Precipitation: Average monthly and yearly
	° F.	° F.	° F.	° F.	° F.	
January-------	71	57.8	49.7	42.5	30	8.23
February------	72	58.9	50.8	42.7	30	6.53
March---------	78	60.4	51.1	41.8	31	5.07
April---------	76	61.5	52.3	43.0	32	3.17
May-----------	80	64.1	54.7	45.2	36	1.57
June----------	87	67.5	57.7	47.7	40	.65
July----------	78	67.1	57.8	48.5	40	.06
August--------	80	67.4	58.2	49.0	41	.14
September-----	97	68.6	59.2	49.7	38	.48
October-------	90	66.1	57.1	48.0	36	2.33
November------	80	62.2	53.6	45.0	30	4.13
December------	76	58.4	50.7	42.9	30	7.26
Year--------	97	63.3	54.4	45.5	30	38.34
Santa Rosa, Calif.						
January-------	71	57.3	46.5	35.7	17	6.02
February------	81	61.8	49.9	37.9	21	5.15
March---------	88	66.3	52.8	39.2	26	3.98
April---------	95	70.4	56.0	41.5	28	2.33
May-----------	104	74.7	59.9	45.0	31	.98
June----------	109	80.5	64.5	48.5	37	.32
July----------	109	83.7	66.8	49.8	40	.02
August--------	106	83.6	66.4	49.2	40	.06
September-----	108	83.9	66.1	48.2	34	.27
October-------	103	77.4	61.0	44.6	26	1.54
November------	91	67.6	53.2	38.8	24	2.94
December------	79	58.6	47.8	37.0	15	5.64
Year--------	109	72.2	57.6	43.0	15	29.95

July. It increases by only one degree in September. In contrast, the average daily maximum temperature in July inland, at Cloverdale, is 92°. Thus, an increase of more than 25° takes place within an airline distance of less than 25 miles. Temperatures of more than 100° have been reported at all inland stations. At several weather stations in the county, temperatures of 112° or higher have been recorded. Along the coast, however, no temperature of 100° has been recorded.

Winters generally are mild, though occasionally cold spells occur. The minimum temperature in January is about 42° along the coast, 36° or 38° throughout cultivated areas, and about 32° in the higher mountain areas. A low of 14° has been recorded in the coldest areas in the mountains, but low temperatures throughout the central part of the county generally range from 15° to 20°. Along the coast low temperatures range from 28° to 30°. Relatively warm temperatures are typical of the afternoons, even during January. In January the daily maximum temperature ranges from about 57° at lower elevations to 55° in the mountains.

The average date of the last temperature of 32° in spring ranges through the month of March in most cultivated areas of the county. It is as early as February 1 along the coast and as late as April 15 in the mountains. Temperatures of 28° or colder occur from January 1 along the coast, through the month of February in much of the county, and to late in March in the mountains. Table 12 shows the probability of receiving temperatures of 32° after specified dates in spring and before specified dates in fall at two weather stations.

The average date of the first 32° temperature in fall is about the middle of November in most of the county, early in November in the mountains, and after December 31 along the coast. The average date of the first temperature of 28° ranges from early in December in colder areas to later than December 31 in warmer areas.

The growing season, which is the interval between the last temperature of 32° F. or lower in spring and the first in fall, ranges from 230 to 260 days in the central part of the county. It is as little as 200 days in the mountains and as much as 340 days along the coast. At a temperature of 28°, the growing season ranges from 260 days in the mountains, to as much as 340 days in the central part of the area, to 365 days along the coast.

TABLE 12.--PROBABILITY OF TEMPERATURES OF 32° AFTER SPECIFIED DATES IN SPRING AND BEFORE SPECIFIED DATES IN FALL

Season and station	Probability (years)									Probability that temperature of 32° will occur in season	Average growing season
	1 in 10	2 in 10	3 in 10	4 in 10	5 in 10	6 in 10	7 in 10	8 in 10	9 in 10		
										Percent	Days
In spring at-											
Fort Ross--	Mar. 16	Feb. 28	Feb. 16	Feb. 3	Jan. 21	Jan. 6	(1/)	(1/)	(1/)	67	344
Santa Rosa-	Apr. 22	Apr. 12	Apr. 5	Mar. 30	Mar. 25	Mar. 20	Mar. 14	Mar. 7	Feb. 25	100	233
In fall at---											
Fort Ross--	Dec. 1	Dec. 8	Dec. 19	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	33	
Santa Rosa-	Oct. 25	Nov. 1	Nov. 4	Nov. 9	Nov. 13	Nov. 16	Nov. 20	Nov. 24	Dec. 1	100	

1/ Earlier than January 1.

2/ Later than December 31.

Precipitation.--The average seasonal precipitation ranges from less than 20 inches in the extreme southeastern corner of the county to 30 to 40 inches throughout much of the central part. The total precipitation is more than 70 inches in places in the mountains in the northwestern part of the county, and it is more than 80 inches in the northeastern part of the county. The total precipitation varies, however, from year to year. For example, in 1 year out of 10 it ranges from about 10 inches in the dry southeastern corner of the county to about 20 to 25 inches in the central part, and from 40 to 50 inches

in the mountains. At the other extreme, in 1 year in 10 the total precipitation is more than 30 inches in the dry southeastern corner, 40 to 50 inches in the interior, and 100 inches in the mountains. Table 13 shows the probability of receiving the total annual precipitation indicated at two weather stations in Sonoma County.

The greatest amount of rainfall in 1 hour is expected to be 0.50 inch about once in 2 years. Every 100 years 1.10 inches is expected in 1 hour. In wetter areas the range is from 0.80 inch in 1 hour in 2 years to 2.00 inches in 2 hours every 100 years.

Little snow falls on most of the county. The average snowfall at low elevations is less than 1 inch per year. In the mountains, where snow falls with some regularity, the annual average is 5 inches or more at higher elevations. More than 25 inches of snow falls in 1 year in places in the mountains in the northeastern part of the county.

Evaporation.--No records of evaporation are kept in the county. Data from places nearby, however, indicate that the average annual amount of moisture that evaporates from a class A pan that is 4 feet in diameter is about 50 inches along the coast and about 80 inches in the warmer, drier, inland areas. The average amount of evaporation from ponds and reservoirs in these areas is about 75 to 85 percent of that for the class A pan.

Wind.--Information about wind in the county is limited. Records covering a 33-month period at the Santa Rosa Air Force Base show that the predominating wind direction is from the south and southeast. Winds of 25 miles per hour or higher were reported only 0.5 percent of the time. Winds of more than 12 miles per hour were reported 10.5 percent of the time, and winds of less than 4 miles per hour 37.8 percent of the time.

Local topography greatly influences wind direction. In general in unprotected areas it can be assumed that winds tend to blow inland from the ocean in the afternoons in summer. At times under similar conditions, marine air flows northward from San Pablo Bay over the southern part of the county. Winter storms bring strong southerly winds to most of the county.

It is estimated that winds reach speeds of 40 miles per hour in most parts of the county as often as once in 2 years and speeds of 80 to 85 miles per hour once in 50 years.

Relative humidity.--The average relative humidity near the coast probably remains near 80 percent the year round. In inland areas relative humidity ranges from 75 percent in winter to about 60 percent in summer and fall. In summer the difference in humidity between the marine air and the drier and warmer air of the inland locations is great.

Sunshine.--Throughout the county sunshine can be expected about 50 percent of the time in winter and up to 60 percent of the time the rest of the year between the hours of sunrise and sunset. In summer sunshine can be expected for 80 percent of these hours in inland areas. Along the coast, however, no more than 60 percent of the hours between sunrise and sunset can be expected to be sunny.

Most of the cloudiness in winter is associated with storms that move inland from the Pacific Ocean. The cloud patterns of these storms are nearly the same in all parts of the county. In summer, however, the cloud patterns are more localized. Low clouds or fog persist most of the summer in a narrow area offshore. Typically the clouds move inland late in the afternoon and spread across much of the county in the evening. At higher elevations the clouds are seen as fog. By midforenoon the clouds start to dissipate over inland areas, and the cloud deck gradually recedes toward the coast. Except for a narrow area along the ocean, the clouds clear away shortly after noon and the rest of the day is sunny.

TABLE 13.--PROBABILITY OF RECEIVING TOTAL ANNUAL PRECIPITATION INDICATED

Station	Probability (percent)								
	5	10	25	33	50	67	75	90	95
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
Fort Ross	22.5	25.5	31.7	34.3	39.5	45.1	48.4	57.3	63.5
Santa Rosa	13.8	16.4	21.2	23.3	27.6	32.1	34.8	42.1	47.6

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Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Bench Terrace. A shelflike embankment of earth that has a level or nearly level top and a steep or vertical downhill face, constructed along the contour of sloping land or across the slope to control runoff and erosion. The downhill face of the bench may be made of rocks or masonry, or it may be planted to vegetation.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Hard grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds that cement the soil grains together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are--

Loose.--Noncoherent; will not hold together in a mass.

Friable.--When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm.--When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.--When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Sticky.--When wet, adheres to other material; tends to stretch somewhat and pull apart, rather than pull free from other material.

Hard.--When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.--When dry, breaks into powder or individual grains under very slight pressure.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and commonly have mottlings in the B and C horizons.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course, and, thus, to protect areas downslope from the effects of such runoff. The ridge is higher and the channel has more capacity than that of a field terrace.

Effective rooting depth. The depth to which a soil is readily penetrated by roots and utilized for extraction of water and plant nutrients. Depth classes are:

	Inches
Very deep	More than 60
Deep	40 to 60
Moderately deep	20 to 40
Shallow	10 to 20
Very shallow	Less than 10

Erosion. The wearing away of the land surface by wind, running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediment, that borders a stream and is subject to flooding unless protected artificially.

Gleization. The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the subsoil or substratum, as a result of poor aeration and drainage; expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gley soil.

Gleyed soil. A soil in which water logging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Irrigation. Application of water to soils to assist in production of crops. Common methods of irrigation are--

Border--Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.--Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.--Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Furrow--Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.--Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Wild flooding.--Irrigation water, which is released at high points, flows onto the field without controlled distribution.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance--few, common, and many; size--fine, medium, and coarse; and contrast--faint, distinct, and prominent. The size measurements are these: fine, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; medium, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and coarse, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables--hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: Very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

pH value. A numerical means for designating relatively weak acidity and alkalinity.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction, because it is neither acid nor alkaline. In words the degrees of acidity or alkalinity are expressed thus:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5-5.0
Strongly acid	5.1-5.5
Medium acid	5.6-6.0
Slightly acid	6.1-6.5
Neutral	6.6-7.3
Mildly alkaline	7.4-7.8
Moderately alkaline	7.9-8.4
Strongly alkaline	8.5-9.0
Very strongly alkaline	9.1 and higher

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Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 millimeter to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soil, slickensides may occur at the base of a slip surface on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying parent material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts runoff so that it may soak into the soil or flow slowly to a prepared outlet. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. (See also Clay, Sand, and Silt.) The basic textural classes, in order of increasing proportions of fine particles are as follows: sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Trace elements. The chemical elements found in soils in extremely small amounts, yet which are essential to plant growth. Some of the trace elements are zinc, cobalt, manganese, and copper.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which the mapping unit belongs. In referring to a capability unit, a range site, a woodland group, or a wildlife group, read the introduction to the section it is in for general information about its management. Dashes in a column mean that the particular mapping unit is not used for the stated purpose. Other information is given in tables or text as follows:

Acreage and extent, table 1, p. 9.
Estimated yields, table 2, p. 103.

Engineering uses of the soils, tables 6, 7, and 8, pp. 126 through 167.

Map symbol	Mapping unit	Page	Capability unit		Range site		Woodland group		Wildlife group		Storie index rating
			Symbol	Page	Number	Page	Number	Page	Number	Page	Number
AdA	Alluvial land, sandy	15	VIIw-4	101	---	---	---	---	2	119	<10
AeA	Alluvial land, clayey	15	IIs-5	95	---	---	---	---	2	119	51
AgB	Arbuckle gravelly sandy loam, 0 to 5 percent slopes	15	IIe-1	94	---	---	---	---	2	119	48
AgD	Arbuckle gravelly sandy loam, 5 to 15 percent slopes	16	IIIe-1	95	---	---	---	---	2	119	45
AgE	Arbuckle gravelly sandy loam, 15 to 30 percent slopes	16	IVe-1	97	---	---	---	---	2	119	37
AkB	Arbuckle gravelly loam, 0 to 5 percent slopes	16	IIe-1	94	---	---	---	---	2	119	61
AkC	Arbuckle gravelly loam, 5 to 9 percent slopes	16	IIIe-1	95	---	---	---	---	2	119	58
AtF	Atwell clay loam, 30 to 50 percent slopes	16	VIe-3	99	---	---	8	118	7	123	25
AtG	Atwell clay loam, 50 to 75 percent slopes	17	VIIe-3	100	---	---	8	118	7	123	13
BaC	Baywood loamy sand, 2 to 9 percent slopes	17	IIIe-4	95	---	---	---	---	2	119	57
BaE	Baywood loamy sand, 9 to 30 percent slopes	18	VIe-4	99	---	---	---	---	2	119	50
BcA	Blucher fine sandy loam, overwash, 0 to 2 percent slopes	19	IIw-2	94	---	---	---	---	2	119	51
BhA	Blucher loam, 0 to 2 percent slopes	18	IIw-2	94	---	---	---	---	2	119	68
BhB	Blucher loam, 2 to 5 percent slopes	19	IIw-2	94	---	---	---	---	2	119	65
BlA	Blucher clay loam, 0 to 2 percent slopes	19	IIw-2	94	---	---	---	---	2	119	55
BlB	Blucher clay loam, 2 to 5 percent slopes	19	IIw-2	94	---	---	---	---	2	119	52
BoE	Boomer loam, 15 to 30 percent slopes	20	IVe-1	97	---	---	1	117	7	123	54
BoF	Boomer loam, 30 to 50 percent slopes	21	VIe-1	99	---	---	2	117	7	123	29
BoG	Boomer loam, 50 to 75 percent slopes	20	VIIe-1	100	---	---	3	117	7	123	18
CaE	Caspar sandy loam, 15 to 30 percent slopes	21	VIe-1	99	---	---	4	117	7	123	52
CaF	Caspar sandy loam, 30 to 50 percent slopes	21	VIe-1	99	---	---	5	117	7	123	26
CbF	Cibo clay, 15 to 50 percent slopes	22	VIe-5	99	3	109	---	---	5	122	24
CcA	Clear Lake clay loam, 0 to 2 percent slopes	23	IIs-5	95	---	---	---	---	2	119	61
CcB	Clear Lake clay loam, 2 to 5 percent slopes	24	IIe-5	94	---	---	---	---	5	122	59
CeA	Clear Lake clay, 0 to 2 percent slopes	22	IIs-5	95	---	---	---	---	2	119	41
CeB	Clear Lake clay, 2 to 5 percent slopes	23	IIe-5	94	---	---	---	---	2	119	41
CfA	Clear Lake clay, ponded, 0 to 2 percent slopes	23	IIIw-5	96	---	---	---	---	2	119	36
CgC	Clough gravelly loam, 2 to 9 percent slopes	24	IIIe-3	95	4	110	---	---	---	---	22
CgD	Clough gravelly loam, 9 to 15 percent slopes	24	IVe-3	97	4	110	---	---	---	---	18

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Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Number	Range site Page	Woodland group Number	Woodland group Page	Wildlife group Number	Wildlife group Page	Storie index rating Number
CgE	Clough gravelly loam, 15 to 30 percent slopes	25	VIe-3	99	4	110	---	---	---	---	13
ChA	Coastal beaches	25	VIIIw-4	102	---	---	---	---	8	123	<5
CmE	Cohasset gravelly loam, 15 to 30 percent slopes	25	IVe-1	97	---	---	1	117	7	123	45
CmF	Cohasset gravelly loam, 30 to 50 percent slopes	25	VIe-1	99	---	---	5	117	7	123	20
CmG	Cohasset gravelly loam, 50 to 75 percent slopes	26	VIIe-1	100	---	---	9	118	7	123	11
CnA	Cole silt loam, 0 to 2 percent slopes	26	IIw-2	94	---	---	---	---	2	119	54
CnB	Cole silt loam, 2 to 5 percent slopes	27	IIw-2	94	---	---	---	---	2	119	52
CoA	Cole clay loam, 0 to 2 percent slopes	27	IIw-2	94	---	---	---	---	2	119	41
CoB	Cole clay loam, 2 to 5 percent slopes	27	IIw-2	94	---	---	---	---	2	119	39
CpG	Comptche gravelly loam, 30 to 75 percent slopes	27	VIIe-1	100	---	---	3	117	7	123	16
CrA	Cortina very gravelly sandy loam, 0 to 2 percent slopes	28	IVs-4	98	---	---	---	---	2	119	25
CsA	Cortina very gravelly loam, 0 to 2 percent slopes	28	IVs-4	98	---	---	---	---	2	119	53
CtC	Cotati fine sandy loam, 2 to 9 percent slopes	29	IIIe-3	95	2	109	---	---	3	122	36
CtD	Cotati fine sandy loam, 9 to 15 percent slopes	30	IVe-3	97	2	109	---	---	3	122	34
CtE	Cotati fine sandy loam, 15 to 30 percent slopes	30	VIe-3	99	2	109	---	---	3	122	27
DbC	Diablo clay, 2 to 9 percent slopes	31	IIe-5	94	---	---	---	---	5	122	44
DbD	Diablo clay, 9 to 15 percent slopes	30	IIIe-5	96	3	109	---	---	5	122	41
DbE	Diablo clay, 15 to 30 percent slopes	31	IVe-5	98	3	109	---	---	5	122	34
DbE2	Diablo clay, 15 to 30 percent slopes, eroded	31	IVe-5	98	3	109	---	---	5	122	31
DbF	Diablo clay, 30 to 50 percent slopes	31	VIe-5	99	7	111	---	---	5	122	18
DbF2	Diablo clay, 30 to 50 percent slopes, eroded	31	VIe-5	99	7	111	---	---	5	122	16
DcC	Dibble clay loam, 2 to 9 percent slopes	32	IIIe-3	95	1	109	---	---	5	122	65
DcD	Dibble clay loam, 9 to 15 percent slopes	32	IVe-3	97	1	109	---	---	5	122	59
DcE	Dibble clay loam, 15 to 30 percent slopes	32	VIe-3	99	1	109	---	---	5	122	48
DcE2	Dibble clay loam, 15 to 30 percent slopes, eroded	33	VIe-3	99	1	109	---	---	5	122	44
DcF	Dibble clay loam, 30 to 50 percent slopes	33	VIe-3	99	5	110	---	---	5	122	24
DcF2	Dibble clay loam, 30 to 50 percent slopes, eroded	33	VIe-3	99	5	110	---	---	5	122	20
DuE	Dune land	33	VIIIe-4	102	---	---	---	---	8	123	<5
EmE	Empire loam, 9 to 30 percent slopes	33	VIe-1	99	---	---	1	117	7	123	57
EmF	Empire loam, 30 to 50 percent slopes	34	VIe-1	99	---	---	2	117	7	123	29
EpF	Empire-Caspar complex, 9 to 50 percent slopes	34	VIe-1	99	---	---	2	117	---	---	34, 32
FaD	Felta very gravelly loam, 5 to 15 percent slopes	35	IVe-4	97	4	110	---	---	4	122	40
FaE	Felta very gravelly loam, 15 to 30 percent slopes	35	VIe-4	99	4	110	---	---	4	122	33
FaF	Felta very gravelly loam, 30 to 50 percent slopes	35	VIe-4	99	8	111	---	---	4	122	15

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Number	Range site Page	Woodland group Number	Woodland group Page	Wildlife group Number	Wildlife group Page	Storie index rating Number
FaG	Felta very gravelly loam, 50 to 75 percent slopes	35	VIIe-4	101	8	111	---	---	4	122	9
FoE	Forward gravelly loam, 9 to 30 percent slopes	36	VIe-8	100	4	110	1	117	7	123	27
FoG	Forward gravelly loam, 30 to 75 percent slopes	36	VIIe-8	101	8	111	9	119	7	123	9
FrG	Forward-Kidd complex, 30 to 75 percent slopes	36	VIIe-8	101	8, 10	111,112	---	---	---	---	9, 7
GdC	Goldridge fine sandy loam, 2 to 9 percent slopes	37	IIIe-1	95	---	---	4	117	7	123	62
GdD	Goldridge fine sandy loam, 9 to 15 percent slopes	37	IVe-1	97	---	---	4	117	7	123	58
GdD2	Goldridge fine sandy loam, 9 to 15 percent slopes, eroded	38	IVe-1	97	---	---	4	117	7	123	49
GdE	Goldridge fine sandy loam, 15 to 30 percent slopes	38	VIe-1	99	---	---	4	117	7	123	51
GdE2	Goldridge fine sandy loam, 15 to 30 percent slopes, eroded	38	VIe-1	99	---	---	4	117	7	123	40
GdF	Goldridge fine sandy loam, 30 to 50 percent slopes	38	VIe-1	99	---	---	5	117	7	123	26
GdF2	Goldridge fine sandy loam, 30 to 50 percent slopes, eroded	38	VIe-1	99	---	---	5	117	7	123	17
GgD	Goulding clay loam, 5 to 15 percent slopes	38	IIIe-1	95	1	109	---	---	4	122	32
GgE	Goulding clay loam, 15 to 30 percent slopes	39	IVe-1	97	1	109	---	---	4	122	31
GgF	Goulding clay loam, 30 to 50 percent slopes	39	VIe-1	99	1	109	---	---	4	122	15
GgF2	Goulding clay loam, 30 to 50 percent slopes, eroded	39	VIe-1	99	1	109	---	---	4	122	12
GgG	Goulding clay loam, 50 to 75 percent slopes	39	VIIe-1	100	5	110	---	---	4	122	9
GlD	Goulding cobbly clay loam, 5 to 15 percent slopes	39	IVe-8	98	4	110	---	---	4	122	25
GlE	Goulding cobbly clay loam, 15 to 30 percent slopes	40	VIe-8	100	4	110	---	---	4	122	20
GlF	Goulding cobbly clay loam, 30 to 50 percent slopes	40	VIIe-8	101	8	111	---	---	4	122	9
GlF2	Goulding cobbly clay loam, 30 to 50 percent slopes, eroded	40	VIIe-8	101	8	111	---	---	4	122	8
GlG	Goulding cobbly clay loam, 50 to 75 percent slopes	40	VIIe-8	101	8	111	---	---	4	122	6
GoF	Goulding-Toomes complex, 9 to 50 percent slopes	40	VIIe-8	101	1, 9	109,112	---	---	---	---	11, 7
GrE	Guenoc gravelly silt loam, 5 to 30 percent slopes	40	VIe-1	99	1	109	---	---	4	122	32
GrG	Guenoc gravelly silt loam, 30 to 75 percent slopes	41	VIIe-1	100	5	110	---	---	4	122	9
GuF	Gullied land	41	VIIIe-1	102	---	---	---	---	8	123	<5
HaB	Haire fine sandy loam, hummocky, 0 to 5 percent slopes	43	IIIe-3	95	---	---	---	---	3	122	42
HbC	Haire gravelly loam, 0 to 9 percent slopes	43	IIIe-3	95	2	109	---	---	3	122	35
HbD	Haire gravelly loam, 9 to 15 percent slopes	43	IVe-3	97	2	109	---	---	3	122	30
HbD2	Haire gravelly loam, 9 to 15 percent slopes, eroded	43	IVe-3	97	2	109	---	---	3	122	25
HbE	Haire gravelly loam, 15 to 30 percent slopes	43	VIe-3	99	2	109	---	---	3	122	22

Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Number	Range site Page	Woodland group Number	Woodland group Page	Wildlife group Number	Wildlife group Page	Storie index rating Number
HcC	Haire clay loam, 0 to 9 percent slopes	42	IIIe-3	95	2	109	---	---	3	122	39
HcD	Haire clay loam, 9 to 15 percent slopes	42	IVe-3	97	2	109	---	---	3	122	34
HcD2	Haire clay loam, 9 to 15 percent slopes, eroded	42	IVe-3	97	2	109	---	---	3	122	28
HcE	Haire clay loam, 15 to 30 percent slopes	42	VIe-3	99	2	109	---	---	3	122	25
HcE2	Haire clay loam, 15 to 30 percent slopes, eroded	42	VIe-3	99	2	109	---	---	3	122	17
HeF	Hely silt loam, 30 to 50 percent slopes	43	VIe-1	99	---	---	2	117	7	123	23
HeG	Hely silt loam, 50 to 75 percent slopes	44	VIIe-1	100	---	---	3	117	7	123	13
HgE	Henneke gravelly loam, 5 to 30 percent slopes	44	VIIe-9	101	11	112	---	---	6	122	16
HgG2	Henneke gravelly loam, 30 to 75 percent slopes, eroded	44	VIIe-9	101	11	112	---	---	6	122	5
HhF	Hugo loam, 30 to 50 percent slopes	45	VIe-1	99	---	---	5	117	7	123	31
HkF	Hugo very gravelly loam, 30 to 50 percent slopes	45	VIe-4	99	---	---	2	117	7	123	23
HkG	Hugo very gravelly loam, 50 to 75 percent slopes	45	VIIe-4	101	---	---	6	118	7	123	12
HkG2	Hugo very gravelly loam, 50 to 75 percent slopes, eroded	45	VIIe-4	101	---	---	6	118	7	123	10
HlF	Hugo-Atwell complex, 30 to 50 percent slopes	46	VIe-4	99	---	---	2, 8	117,118	---	---	23, 25
HlG	Hugo-Atwell complex, 50 to 75 percent slopes	46	VIIe-4	101	---	---	2, 8	117,118	---	---	12, 13
HmF	Hugo-Boomer complex, 30 to 50 percent slopes	46	VIe-4	99	---	---	2	117	---	---	23, 29
HmG	Hugo-Boomer complex, 50 to 75 percent slopes	46	VIIe-4	101	---	---	6, 3	118,117	---	---	13, 18
HnE	Hugo-Josephine complex, 9 to 30 percent slopes	46	VIe-1	99	---	---	1	117	---	---	46, 58
HnG	Hugo-Josephine complex, 50 to 75 percent slopes	46	VIIe-4	101	---	---	6, 3	118,117	---	---	12, 15
HnG2	Hugo-Josephine complex, 50 to 75 percent slopes, eroded	47	VIIe-4	101	---	---	6	118	---	---	10, 13
HoG	Hugo-Laughlin complex, 30 to 75 percent slopes	47	VIIe-8	101	3	109	6	118	---	---	16, 13
HrG	Hugo-Los Gatos complex, 50 to 75 percent slopes	47	VIIe-4	101	10	112	6	118	---	---	17, 11
HsF	Hugo-Hely complex, 30 to 50 percent slopes	47	VIe-4	99	---	---	2	117	---	---	23, 23
HsG	Hugo-Hely complex, 50 to 75 percent slopes	47	VIIe-4	101	---	---	6, 3	118,117	---	---	13, 13
HtA	Huichica loam, 0 to 2 percent slopes	48	IIIs-3	97	---	---	---	---	3	122	28
HtC	Huichica loam, 2 to 9 percent slopes	48	IIIe-3	95	---	---	---	---	3	122	26
HtD	Huichica loam, 9 to 15 percent slopes	49	IVe-3	97	---	---	---	---	3	122	24
HuB	Huichica loam, ponded, 0 to 5 percent slopes	49	IIIw-3	96	---	---	---	---	3	122	24
HvC	Huichica loam, shallow, 0 to 9 percent slopes	49	IVe-3	97	---	---	---	---	3	122	23
HwB	Huichica loam, shallow, ponded, 0 to 5 percent slopes	49	IVw-3	98	---	---	---	---	3	122	21
HyG	Huse stony clay loam, 30 to 75 percent slopes	49	VIIe-9	101	11	112	---	---	6	122	7

Map symbol	Mapping unit	Page	Capability unit		Range site		Woodland group		Wildlife group		Storie index rating
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JoE	Josephine loam, 9 to 30 percent slopes	51	IVe-1	97	---	---	1	117	7	123	58
JoF	Josephine loam, 30 to 50 percent slopes	51	VIe-1	99	---	---	2	117	7	123	26
JoF2	Josephine loam, 30 to 50 percent slopes, eroded	51	VIe-1	99	---	---	2	117	7	123	20
JoG	Josephine loam, 50 to 75 percent slopes	50	VIIe-1	100	---	---	3	117	7	123	15
JsG	Josephine-Sites loams, 30 to 75 percent slopes	51	VIIe-1	100	---	---	3, 7	117,118	---	---	18, 17
KdF	Kidd gravelly loam, 9 to 50 percent slopes	51	VIIe-8	101	10	112	---	---	6	122	11
KeE	Kidd stony loam, 2 to 30 percent slopes	52	VIe-8	100	10	112	---	---	6	122	14
KkG	Kidd very rocky loam, 30 to 75 percent slopes	52	VIIs-8	102	10	112	---	---	6	122	4
KlD	Kinman loam, 5 to 15 percent slopes	53	IVe-3	97	2	109	---	---	5	122	48
KlE	Kinman loam, 15 to 30 percent slopes	53	VIe-3	99	2	109	---	---	5	122	40
KlF	Kinman loam, 30 to 50 percent slopes	52	VIe-3	99	6	111	---	---	5	122	19
KmF	Kinman-Kneeland loams, 30 to 50 percent slopes	53	VIe-3	99	6, 12	111,113	---	---	---	---	19, 16
KnC	Kneeland loam, 5 to 9 percent slopes	54	IIIe-1	95	12	113	---	---	5	122	44
KnD	Kneeland loam, 9 to 15 percent slopes	54	IVe-1	97	12	113	---	---	5	122	38
KnE	Kneeland loam, 15 to 30 percent slopes	54	VIe-1	99	12	113	---	---	5	122	33
KnF	Kneeland loam, 30 to 50 percent slopes	54	VIe-1	99	12	113	---	---	5	122	30
KoG	Kneeland rocky complex, 30 to 75 percent slopes	54	VIIe-1	100	12	113	---	---	5	122	9
KsD	Kneeland sandy loam, sandy variant, 2 to 15 percent slopes	55	IVe-1	97	12	113	---	---	5	122	52
KsE	Kneeland sandy loam, sandy variant, 15 to 30 percent slopes	55	VIe-4	99	12	113	---	---	5	122	40
KvE	Kneeland rocky sandy loam, sandy variant, 9 to 30 percent slopes	55	VIe-4	99	12	113	---	---	5	122	18
LaC	Laniger loam, 5 to 9 percent slopes	56	IIIe-1	95	---	---	---	---	4	122	58
LaD	Laniger loam, 9 to 15 percent slopes	56	IVe-1	97	4	110	---	---	4	122	47
LaE	Laniger loam, 15 to 30 percent slopes	56	VIe-1	99	4	110	---	---	4	122	35
LaE2	Laniger loam, 15 to 30 percent slopes, eroded	56	VIe-1	99	4	110	---	---	4	122	29
LaF	Laniger loam, 30 to 50 percent slopes	56	VIe-1	99	8	111	---	---	4	122	21
LgE	Laughlin loam, 2 to 30 percent slopes	57	IVe-8	98	4	110	---	---	4	122	41
LgF	Laughlin loam, 30 to 50 percent slopes	57	VIe-8	100	4	110	---	---	4	122	19
LgG	Laughlin loam, 50 to 75 percent slopes	57	VIIe-8	101	8	111	---	---	4	122	11
LgG2	Laughlin loam, 50 to 75 percent slopes, eroded	57	VIIe-8	101	8	111	---	---	4	122	9
LhG	Laughlin-Yorkville complex, 30 to 75 percent slopes	57	VIIe-8	101	8, 6	111,111	---	---	---	---	14, 13
LkG	Los Gatos loam, 30 to 75 percent slopes	58	VIIe-8	101	10	112	---	---	6	122	14
LmG	Los Gatos gravelly loam, 30 to 75 percent slopes	58	VIIe-8	101	10	112	---	---	6	122	10
LnG	Los Gatos-Josephine complex, 30 to 75 percent slopes	58	VIIe-8	101	10	112	---	---	---	---	14, 18

Map symbol	Mapping unit	Page	Capability unit		Range site		Woodland group		Wildlife group		Storie index rating
			Symbol	Page	Number	Page	Number	Page	Number	Page	Number
LoD	Los Osos clay loam, 2 to 15 percent slopes	59	IIIe-3	95	1	109	---	---	5	122	51
LoE	Los Osos clay loam, 15 to 30 percent slopes	59	IVe-3	97	1	109	---	---	5	122	39
LoF	Los Osos clay loam, 30 to 50 percent slopes	60	VIe-3	99	1	109	---	---	5	122	18
LoF2	Los Osos clay loam, 30 to 50 percent slopes, eroded	60	VIe-3	99	1	109	---	---	5	122	14
LsD	Los Osos clay loam, thin solum, 5 to 15 percent slopes	60	IVe-3	97	4	110	---	---	5	122	31
LsE	Los Osos clay loam, thin solum, 15 to 30 percent slopes	60	VIe-3	99	4	110	---	---	5	122	15
LsE2	Los Osos clay loam, thin solum, 15 to 30 percent slopes, eroded	60	VIe-3	99	4	110	---	---	5	122	11
LsF2	Los Osos clay loam, thin solum, 30 to 50 percent slopes, eroded	60	VIIe-3	100	8	111	---	---	5	122	10
LuA	Los Robles gravelly clay loam, 0 to 2 percent slopes	61	IIs-4	94	---	---	---	---	2	119	68
LvB	Los Robles gravelly clay loam, moderately deep, 0 to 5 percent slopes	61	IIe-1	94	---	---	---	---	2	119	58
MbC	Manzanita gravelly silt loam, 0 to 9 percent slopes	61	IIe-1	94	---	---	---	---	2	119	58
McF	Maymen gravelly sandy loam, 30 to 50 percent slopes	62	VIIe-8	101	10	112	---	---	6	122	9
MlG	Maymen-Los Gatos complex, 30 to 75 percent slopes	63	VIIe-8	101	10	112	---	---	---	---	9, 14
MmE	Mendocino sandy clay loam, 9 to 30 percent slopes	63	VIe-1	99	---	---	1	117	7	123	55
MmF	Mendocino sandy clay loam, 30 to 50 percent slopes	64	VIe-1	99	---	---	2	117	7	123	24
MnF	Mendoncino-Empire complex, 0 to 50 percent slopes	64	VIe-1	99	---	---	2	117	---	---	45, 50
MoE	Montara cobbly clay loam, 2 to 30 percent slopes	64	VIIe-9	101	11	112	---	---	6	122	12
MoG	Montara cobbly clay loam, 30 to 75 percent slopes	64	VIIe-9	101	11	112	---	---	6	122	4
NoD	Noyo coarse sandy loam, 0 to 15 percent slopes	65	IVe-3	97	2	109	---	---	3	122	29
PaA	Pajaro fine sandy loam, 0 to 2 percent slopes	66	IIw-2	94	---	---	---	---	2	119	77
PaB	Pajaro fine sandy loam, 2 to 5 percent slopes	66	IIw-2	94	---	---	---	---	2	119	73
PbB	Pajaro gravelly loam, 0 to 5 percent slopes	66	IIw-2	94	---	---	---	---	2	119	62
PcA	Pajaro clay loam, overwash, 0 to 2 percent slopes	66	IIIw-2	96	---	---	---	---	2	119	51
PcB	Pajaro clay loam, overwash, 2 to 5 percent slopes	67	IIIw-2	96	---	---	---	---	2	119	48
PeA	Pleasanton loam, 0 to 2 percent slopes	68	I-1	93	---	---	---	---	2	119	81
PeC	Pleasanton loam, 2 to 9 percent slopes	68	IIe-1	94	---	---	---	---	2	119	73
PgB	Pleasanton gravelly loam, 2 to 5 percent slopes	67	IIe-1	94	---	---	---	---	2	119	61
PhB	Pleasanton clay loam, 2 to 5 percent slopes	68	IIe-1	94	---	---	---	---	2	119	58
PkC	Pleasanton gravelly clay loam, 2 to 9 percent slopes	68	IIe-1	94	---	---	---	---	2	119	45
PlC	Pleasanton-Haire complex, 0 to 9 percent slopes	68	IIIe-3	95	---	---	---	---	---	---	55, 44

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Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Number	Range site Page	Woodland group Number	Woodland group Page	Wildlife group Number	Wildlife group Page	Storie index rating Number
PlD	Pleasanton-Haire complex, 9 to 15 percent slopes	68	IVe-3	97	---	---	---	---	---	---	51, 41
PsC	Positas gravelly loam, 0 to 9 percent slopes	69	IIIe-3	95	---	---	---	---	3	122	31
PsD	Positas gravelly loam, 9 to 15 percent slopes	69	IVe-3	97	---	---	---	---	3	122	26
RaC	Raynor clay, 2 to 9 percent slopes	70	IIe-5	94	---	---	---	---	5	122	44
RaD	Raynor clay, 9 to 15 percent slopes	70	IIIe-5	96	---	---	---	---	5	122	39
RaE	Raynor clay, 15 to 30 percent slopes	70	IVe-5	98	3	109	---	---	5	122	32
RcD	Raynor clay, seeped, 2 to 15 percent slopes	70	VIw-5	100	3	109	---	---	5	122	33
ReE	Raynor-Montara complex, 0 to 30 percent slopes	70	VIe-5	99	3, 11	109,112	---	---	---	---	36, 12
RhD	Red Hill clay loam, 2 to 15 percent slopes	72	IIIe-1	95	---	---	1	117	7	123	62
RhE	Red Hill clay loam, 15 to 30 percent slopes	72	IVe-1	97	---	---	1	117	7	123	55
RhF	Red Hill clay loam, 30 to 50 percent slopes	71	VIe-1	99	---	---	7	118	7	123	29
RlG	Red Hill cobbly clay loam, 30 to 75 percent slopes	72	VIIe-7	101	---	---	9	118	7	123	16
RmA	Reyes silty clay, 0 to 2 percent slopes	72	IVw-9	98	---	---	---	---	1	119	45
RnA	Riverwash	73	VIIIw-4	102	---	---	---	---	8	123	<5
RoG	Rock land	73	VIIIs-8	102	---	---	---	---	8	123	<5
RrC	Rohnerville loam, 0 to 9 percent slopes	74	IIIe-1	95	1	109	---	---	3	122	65
RrD	Rohnerville loam, 9 to 15 percent slopes	74	IVe-1	97	1	109	---	---	3	122	54
SbC	Sebastopol sandy loam, 2 to 9 percent slopes	75	IIIe-1	95	---	---	---	---	4	122	69
SbD	Sebastopol sandy loam, 9 to 15 percent slopes	75	IVe-1	97	---	---	---	---	4	122	62
SbD2	Sebastopol sandy loam, 9 to 15 percent slopes, eroded	75	IVe-1	97	2	109	---	---	4	122	56
SbE	Sebastopol sandy loam, 15 to 30 percent slopes	76	VIe-1	99	2	109	---	---	4	122	55
SeE	Sheridan coarse sandy loam, 2 to 30 percent slopes	76	VIe-4	99	---	---	---	---	5	122	49
SfE	Sites loam, 5 to 30 percent slopes	76	VIe-1	99	---	---	1	117	7	123	55
SfF	Sites loam, 30 to 50 percent slopes	77	VIIe-1	100	---	---	7	118	7	123	24
ShE	Sobrante loam, 15 to 30 percent slopes	78	IVe-1	97	4	110	---	---	4	122	38
ShF	Sobrante loam, 30 to 50 percent slopes	77	VIe-1	99	4	110	---	---	4	122	19
ShG	Sobrante loam, 50 to 75 percent slopes	78	VIIe-1	100	8	111	---	---	4	122	10
SkC	Spreckels loam, 2 to 9 percent slopes	79	IIIe-3	95	---	---	---	---	4	122	37
SkD	Spreckels loam, 9 to 15 percent slopes	79	IVe-3	97	2	109	---	---	4	122	38
SkE	Spreckels loam, 15 to 30 percent slopes	78	VIe-3	99	2	109	---	---	4	122	34
SkE2	Spreckels loam, 15 to 30 percent slopes, eroded	79	VIe-3	99	2	109	---	---	4	122	27
SkF	Spreckels loam, 30 to 50 percent slopes	79	VIe-3	99	6	111	---	---	4	122	15
SnC	Steinbeck loam, 2 to 9 percent slopes	80	IIIe-1	95	---	---	---	---	5	122	58

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Map symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Number	Range site Page	Woodland group Number	Woodland group Page	Wildlife group Number	Wildlife group Page	Storie index rating Number
SnD	Steinbeck loam, 9 to 15 percent slopes	80	IVe-1	97	1	109	---	---	5	122	58
SnD2	Steinbeck loam, 9 to 15 percent slopes, eroded	81	IVe-1	97	1	109	---	---	5	122	52
SnE	Steinbeck loam, 15 to 30 percent slopes	81	VIe-1	99	1	109	---	---	5	122	48
SnE2	Steinbeck loam, 15 to 30 percent slopes, eroded	81	VIe-1	99	1	109	---	---	5	122	40
SnF	Steinbeck loam, 30 to 50 percent slopes	81	VIe-1	99	5	110	---	---	5	122	22
SnF2	Steinbeck loam, 30 to 50 percent slopes, eroded	81	VIe-1	99	5	110	---	---	5	122	20
SoF	Stonyford gravelly loam, 30 to 50 percent slopes	82	VIIe-8	101	10	112	---	---	6	122	11
SoG	Stonyford gravelly loam, 50 to 75 percent slopes	81	VIIe-8	101	10	112	---	---	6	122	6
SrG	Stonyford-Boomer complex, 30 to 75 percent slopes	82	VIIe-8	101	10	112	---	---	---	---	8, 20
SsG	Supan silt loam, 30 to 75 percent slopes	82	VIIe-1	100	5	110	---	---	4	122	20
StE	Suther loam, 15 to 30 percent slopes	83	VIe-3	99	2	109	---	---	5	122	41
StE2	Suther loam, 15 to 30 percent slopes, eroded	84	VIe-3	99	2	109	---	---	5	122	32
StF	Suther loam, 30 to 50 percent slopes	84	VIe-3	99	6	111	---	---	5	122	19
SuF	Suther-Laughlin loams, 15 to 50 percent slopes	84	VIe-3	99	6, 8	111,111	---	---	---	---	27, 26
SuG	Suther-Laughlin loams, 50 to 75 percent slopes	84	VIIe-3	100	6, 8	111,111	---	---	---	---	12, 10
TeG	Terrace escarpments	84	VIIIs-8	102	---	---	---	---	8	123	5
TmA	Tidal marsh	84	VIIIw-2	102	---	---	---	---	1	119	5
ToE	Toomes rocky loam, 2 to 30 percent slopes	85	VIIe-8	101	9	112	---	---	6	122	14
ToG	Toomes rocky loam, 30 to 75 percent slopes	85	VIIe-8	101	9	112	---	---	6	122	4
TuC	Tuscan cobbly clay loam, 0 to 9 percent slopes	85	IVe-3	97	9	112	---	---	2	119	13
TuE	Tuscan cobbly clay loam, 9 to 30 percent slopes	86	VIe-3	99	9	112	---	---	2	119	12
WgC	Wright loam, 0 to 9 percent slopes	87	IIIe-3	95	---	---	---	---	3	122	40
WhA	Wright loam, wet, 0 to 2 percent slopes	86	IIIw-3	96	---	---	---	---	3	122	36
WmB	Wright loam, shallow, 0 to 5 percent slopes	87	IVe-3	97	---	---	---	---	3	122	35
WoA	Wright loam, shallow, wet, 0 to 2 percent slopes	87	IVw-3	98	---	---	---	---	3	122	29
YlA	Yolo sandy loam, 0 to 2 percent slopes	88	I-1	93	---	---	---	---	2	119	90
YmB	Yolo sandy loam, overwash, 0 to 5 percent slopes	88	IIw-2	94	---	---	---	---	2	119	65
YnA	Yolo loam, 0 to 2 percent slopes	88	I-1	93	---	---	---	---	2	119	100
YoB	Yolo loam, overwash, 0 to 5 percent slopes	88	IIw-2	94	---	---	---	---	2	119	72
YrB	Yolo gravelly loam, 0 to 5 percent slopes	88	IIe-1	94	---	---	---	---	2	119	69
YsA	Yolo silt loam, 0 to 2 percent slopes	88	I-1	93	---	---	---	---	2	119	100
YtA	Yolo clay loam, 0 to 2 percent slopes	88	I-1	93	---	---	---	---	2	119	85
YuE	Yorkville clay loam, 5 to 30 percent slopes	89	VIe-3	99	2	109	---	---	5	122	39

Map symbol	Mapping unit	Page	Capability unit		Range site		Woodland group		Wildlife group		Storie index rating
			Symbol	Page	Number	Page	Number	Page	Number	Page	Number
YuF	Yorkville clay loam, 30 to 50 percent slopes--------------------	89	VIe-3	99	6	111	---	---	5	122	16
YvF	Yorkville-Laughlin complex, 30 to 50 percent slopes--------------------	89	VIe-3	99	6, 4	111,110	---	---	---	---	18, 19
YwF	Yorkville-Suther complex, 0 to 50 percent slopes--------------------	90	VIe-3	99	6	111	---	---	---	---	31, 35
YwG	Yorkville-Suther complex, 50 to 75 percent slopes--------------------	90	VIIe-3	100	6	111	---	---	---	---	10, 12
ZaA	Zamora silty clay loam, 0 to 2 percent slopes--------------------	90	I-1	93	---	---	---	---	2	119	86
ZaB	Zamora silty clay loam, 2 to 5 percent slopes--------------------	91	IIe-1	94	---	---	---	---	2	119	81

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Persons with Disabilities

If you are deaf, are hard of hearing, or have speech disabilities and you wish to file either an EEO or program complaint, please contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish).

If you have other disabilities and wish to file a program complaint, please see the contact information above. If you require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.), please contact USDA's TARGET Center at (202) 720-2600 (voice and TDD).

Supplemental Nutrition Assistance Program

For additional information dealing with Supplemental Nutrition Assistance Program (SNAP) issues, call either the USDA SNAP Hotline Number at (800) 221-5689, which is also in Spanish, or the State Information/Hotline Numbers (http://directives.sc.egov.usda.gov/33085.wba).

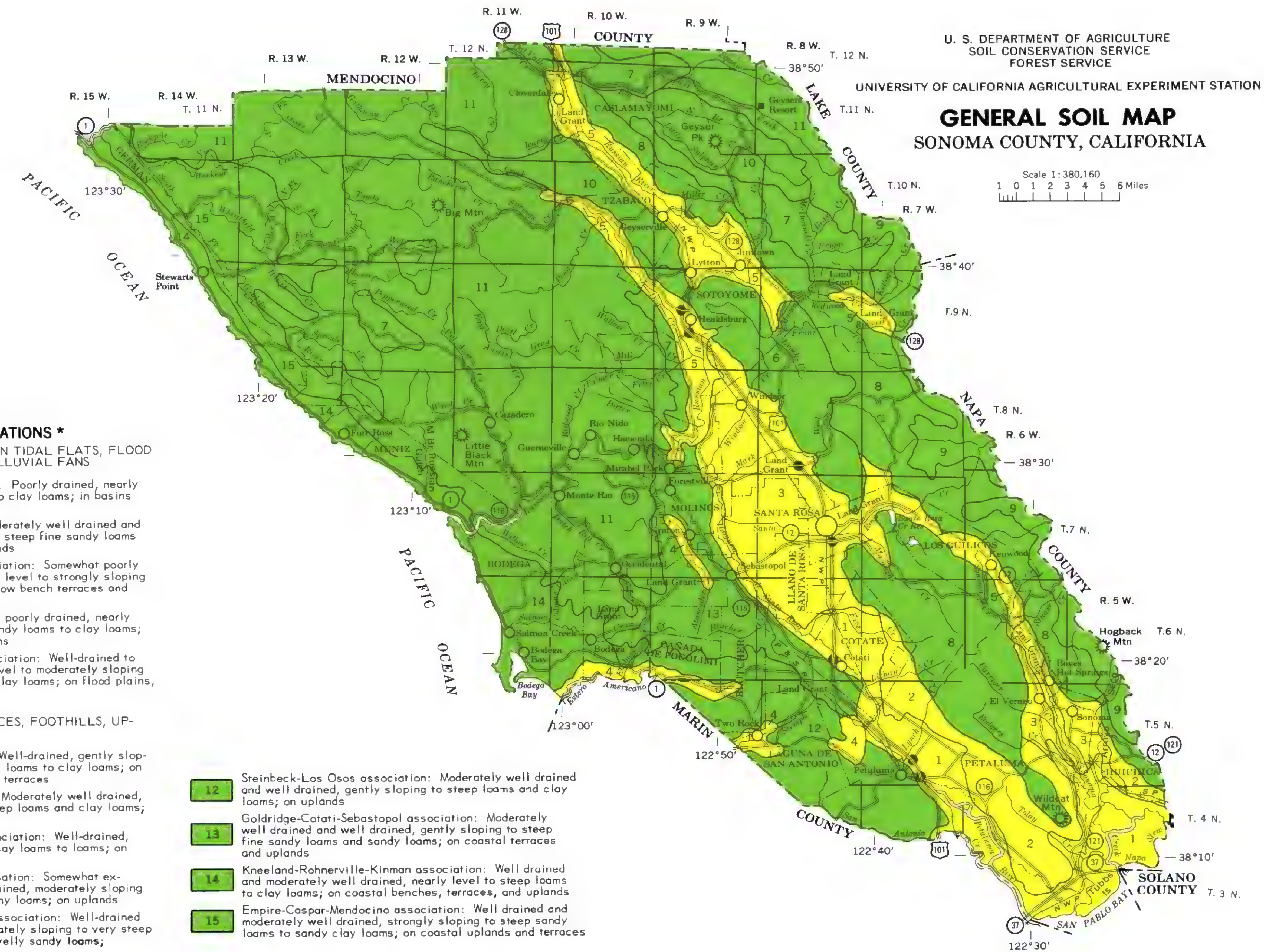
All Other Inquires

For information not pertaining to civil rights, please refer to the listing of the USDA Agencies and Offices (http://directives.sc.egov.usda.gov/33086.wba).

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FOREST SERVICE

UNIVERSITY OF CALIFORNIA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
SONOMA COUNTY, CALIFORNIA



SOIL ASSOCIATIONS *

SOILS IN THE BASINS AND ON TIDAL FLATS, FLOOD PLAINS, TERRACES, AND ALLUVIAL FANS

1 — Clear Lake-Reyes association: Poorly drained, nearly level to gently sloping clays to clay loams; in basins and on tidal flats

2 — Haire-Diablo association: Moderately well drained and well drained, gently sloping to steep fine sandy loams to clays; on terraces and uplands

3 — Huichica-Wright-Zamora association: Somewhat poorly drained to well-drained, nearly level to strongly sloping loams to silty clay loams; on low bench terraces and alluvial fans

4 — Pajaro association: Somewhat poorly drained, nearly level to gently sloping fine sandy loams to clay loams; on low terraces and flood plains

5 — Yolo-Cortina-Pleasanton association: Well-drained to excessively drained, nearly level to moderately sloping very gravelly sandy loams to clay loams; on flood plains, alluvial fans, and low terraces

SOILS OF THE HIGH TERRACES, FOOTHILLS, UPLANDS, AND MOUNTAINS

6 — Spreckels-Felta association: Well-drained, gently sloping to very steep very gravelly loams to clay loams; on mountain foothills and on high terraces

7 — Yorkville-Suther association: Moderately well drained, moderately sloping to very steep loams and clay loams; on uplands

8 — Goulding-Toomes-Guenoc association: Well-drained, gently sloping to very steep clay loams to loams; on uplands

9 — Kidd-Forward-Cohasset association: Somewhat excessively drained and well-drained, moderately sloping to very steep gravelly and stony loams; on uplands

10 — Los Gatos-Henneke-Maymen association: Well-drained to excessively drained, moderately sloping to very steep **loams**, gravelly loams and gravelly sandy **loams**; on mountains

11 — Hugo-Josephine-Laughlin association: Well-drained, gently sloping to very steep gravelly loams and loams; on mountains

12 — Steinbeck-Los Osos association: Moderately well drained and well drained, gently sloping to steep loams and clay loams; on uplands

13 — Goldridge-Cotati-Sebastopol association: Moderately well drained and well drained, gently sloping to steep fine sandy loams and sandy loams; on coastal terraces and uplands

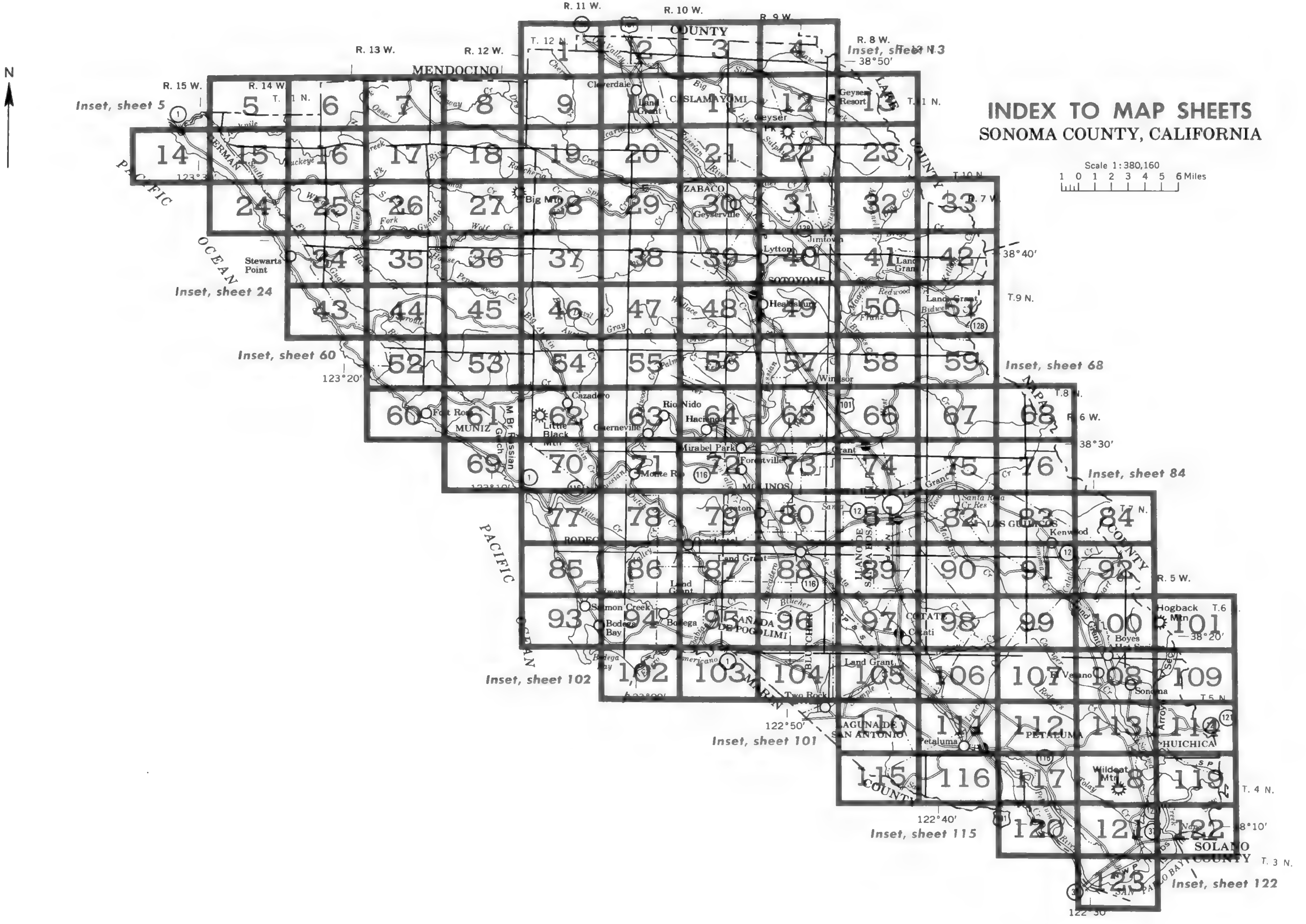
14 — Kneeland-Rohnerville-Kinman association: Well drained and moderately well drained, nearly level to steep loams to clay loams; on coastal benches, terraces, and uplands

15 — Empire-Caspar-Mendocino association: Well drained and moderately well drained, strongly sloping to steep sandy loams to sandy clay loams; on coastal uplands and terraces

* Textures described in these soil associations are for the surface layer

This map is for general planning. It shows only the major soils and does not contain sufficient detail for operational planning.

Published 1971


INDEX TO MAP SHEETS
SONOMA COUNTY, CALIFORNIA
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1 0 1 2 3 4 5 6 Miles
N
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Cazadero
Stewarts Point
Bodega Bay
Bodega
Cotati
Petaluma
Sonoma
Kenwood
Two Rock
R. 15 W.
R. 14 W.
R. 13 W.
R. 12 W.
R. 11 W.
R. 10 W.
R. 9 W.
R. 8 W.
R. 7 W.
R. 6 W.
R. 5 W.
T. 12 N.
T. 11 N.
T. 10 N.
T. 9 N.
T. 8 N.
T. 7 N.
T. 6 N.
T. 5 N.
T. 4 N.
T. 3 N.
38°50'
38°40'
38°30'
38°20'
38°10'
123°20'
122°50'
122°40'
122°30'

SOIL LEGEND

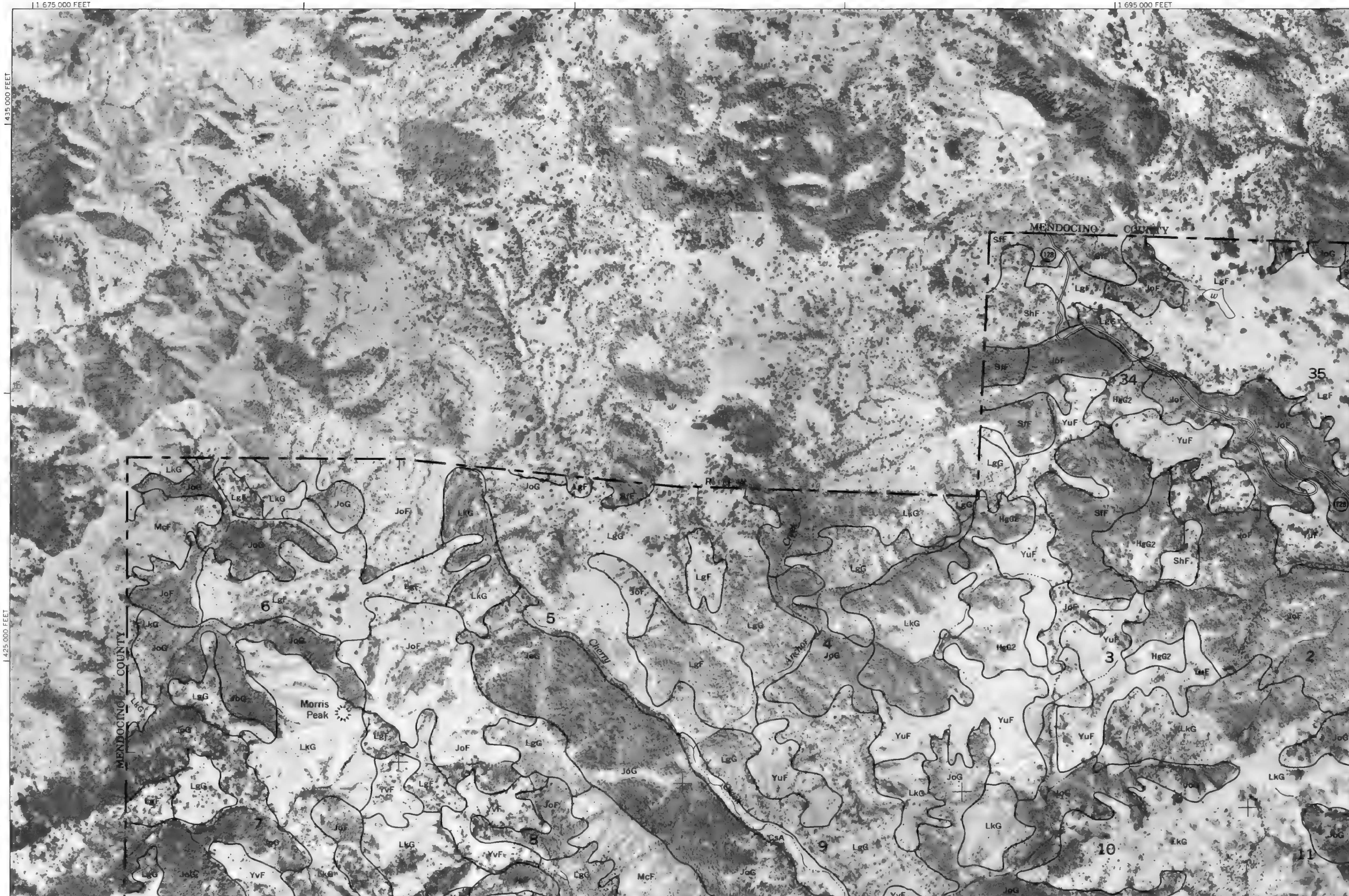
Each symbol consists of letters or a combination of letters and numbers. The first capital letter is the initial one of the soil name. A second capital letter shows the class of slope. A final number, 2, in a symbol indicates that the soil is eroded.

SYMBOL	NAME
AdA	Alluvial land, sandy
AeA	Alluvial land, clayey
AgB	Arbuckle gravelly sandy loam, 0 to 5 percent slopes
AgD	Arbuckle gravelly sandy loam, 5 to 15 percent slopes
AgE	Arbuckle gravelly sandy loam, 15 to 30 percent slopes
AkB	Arbuckle gravelly loam, 0 to 5 percent slopes
AkC	Arbuckle gravelly loam, 5 to 9 percent slopes
AtF	Atwell clay loam, 30 to 50 percent slopes
AtG	Atwell clay loam, 50 to 75 percent slopes
BaC	Baywood loamy sand, 2 to 9 percent slopes
BaE	Baywood loamy sand, 9 to 30 percent slopes
BcA	Blucher fine sandy loam, overwash, 0 to 2 percent slopes
BhA	Blucher loam, 0 to 2 percent slopes
BhB	Blucher loam, 2 to 5 percent slopes
BlA	Blucher clay loam, 0 to 2 percent slopes
BlB	Blucher clay loam, 2 to 5 percent slopes
BoE	Boomer loam, 15 to 30 percent slopes
BoF	Boomer loam, 30 to 50 percent slopes
BoG	Boomer loam, 50 to 75 percent slopes
CaE	Caspar sandy loam, 15 to 30 percent slopes
CaF	Caspar sandy loam, 30 to 50 percent slopes
CbF	Cibo clay, 15 to 50 percent slopes
CcA	Clear Lake clay loam, 0 to 2 percent slopes
CcB	Clear Lake clay loam, 2 to 5 percent slopes
CeA	Clear Lake clay, 0 to 2 percent slopes
CeB	Clear Lake clay, 2 to 5 percent slopes
CfA	Clear Lake clay, ponded, 0 to 2 percent slopes
CgC	Clough gravelly loam, 2 to 9 percent slopes
CgD	Clough gravelly loam, 9 to 15 percent slopes
CgE	Clough gravelly loam, 15 to 30 percent slopes
ChA	Coastal beaches
CmE	Cohasset gravelly loam, 15 to 30 percent slopes
CmF	Cohasset gravelly loam, 30 to 50 percent slopes
CmG	Cohasset gravelly loam, 50 to 75 percent slopes
CnA	Cole silt loam, 0 to 2 percent slopes
CnB	Cole silt loam, 2 to 5 percent slopes
CoA	Cole clay loam, 0 to 2 percent slopes
CoB	Cole clay loam, 2 to 5 percent slopes
CpG	Comptche gravelly loam, 30 to 75 percent slopes
CrA	Cortina very gravelly sandy loam, 0 to 2 percent slopes
CsA	Cortina very gravelly loam, 0 to 2 percent slopes
CtC	Cotati fine sandy loam, 2 to 9 percent slopes
CtD	Cotati fine sandy loam, 9 to 15 percent slopes
CtE	Cotati fine sandy loam, 15 to 30 percent slopes
DbC	Diablo clay, 2 to 9 percent slopes
DbD	Diablo clay, 9 to 15 percent slopes
DbE	Diablo clay, 15 to 30 percent slopes
DbE2	Diablo clay, 15 to 30 percent slopes, eroded
DbF	Diablo clay, 30 to 50 percent slopes
DbF2	Diablo clay, 30 to 50 percent slopes, eroded
DcC	Dibble clay loam, 2 to 9 percent slopes
DcD	Dibble clay loam, 9 to 15 percent slopes
DcE	Dibble clay loam, 15 to 30 percent slopes
DcE2	Dibble clay loam, 15 to 30 percent slopes, eroded
DcF	Dibble clay loam, 30 to 50 percent slopes
DcF2	Dibble clay loam, 30 to 50 percent slopes, eroded
DuE	Dune land
EmE	Empire loam, 9 to 30 percent slopes
EmF	Empire loam, 30 to 50 percent slopes
EpF	Empire-Caspar complex, 9 to 50 percent slopes
FaD	Felta very gravelly loam, 5 to 15 percent slopes
FaE	Felta very gravelly loam, 15 to 30 percent slopes
FaF	Felta very gravelly loam, 30 to 50 percent slopes
FaG	Felta very gravelly loam, 50 to 75 percent slopes
FoE	Forward gravelly loam, 9 to 30 percent slopes
FoG	Forward gravelly loam, 30 to 75 percent slopes
FrG	Forward-Kidd complex, 30 to 75 percent slopes
GdC	Goldridge fine sandy loam, 2 to 9 percent slopes
GdD	Goldridge fine sandy loam, 9 to 15 percent slopes
GdD2	Goldridge fine sandy loam, 9 to 15 percent slopes, eroded
GdE	Goldridge fine sandy loam, 15 to 30 percent slopes
GdE2	Goldridge fine sandy loam, 15 to 30 percent slopes, eroded
GdF	Goldridge fine sandy loam, 30 to 50 percent slopes
GdF2	Goldridge fine sandy loam, 30 to 50 percent slopes, eroded
GgD	Goulding clay loam, 5 to 15 percent slopes
GgE	Goulding clay loam, 15 to 30 percent slopes
GgF	Goulding clay loam, 30 to 50 percent slopes
GgF2	Goulding clay loam, 30 to 50 percent slopes, eroded
GgG	Goulding clay loam, 50 to 75 percent slopes
GlD	Goulding cobbly clay loam, 5 to 15 percent slopes
GlE	Goulding cobbly clay loam, 15 to 30 percent slopes
GlF	Goulding cobbly clay loam, 30 to 50 percent slopes
GlF2	Goulding cobbly clay loam, 30 to 50 percent slopes, eroded
GlG	Goulding cobbly clay loam, 50 to 75 percent slopes
GoF	Goulding-Toomes complex, 9 to 50 percent slopes
GrE	Guenoc gravelly silt loam, 5 to 30 percent slopes
GrG	Guenoc gravelly silt loam, 30 to 75 percent slopes
GuF	Gullied land
HaB	Haire fine sandy loam, hummocky, 0 to 5 percent slopes
HbC	Haire gravelly loam, 0 to 9 percent slopes
HbD	Haire gravelly loam, 9 to 15 percent slopes
HbD2	Haire gravelly loam, 9 to 15 percent slopes, eroded
HbE	Haire gravelly loam, 15 to 30 percent slopes
HcC	Haire clay loam, 0 to 9 percent slopes
HcD	Haire clay loam, 9 to 15 percent slopes
HcD2	Haire clay loam, 9 to 15 percent slopes, eroded
HcE	Haire clay loam, 15 to 30 percent slopes
HcE2	Haire clay loam, 15 to 30 percent slopes, eroded
HeF	Hely silt loam, 30 to 50 percent slopes
HeG	Hely silt loam, 50 to 75 percent slopes
HgE	Henneke gravelly loam, 5 to 30 percent slopes
HgG2	Henneke gravelly loam, 30 to 75 percent slopes, eroded
HhF	Hugo loam, 30 to 50 percent slopes
HkF	Hugo very gravelly loam, 30 to 50 percent slopes
HkG	Hugo very gravelly loam, 50 to 75 percent slopes
HkG2	Hugo very gravelly loam, 50 to 75 percent slopes, eroded
HlF	Hugo-Atwell complex, 30 to 50 percent slopes
HlG	Hugo-Atwell complex, 50 to 75 percent slopes
HmF	Hugo-Boomer complex, 30 to 50 percent slopes
HmG	Hugo-Boomer complex, 50 to 75 percent slopes
HnE	Hugo-Josephine complex, 9 to 30 percent slopes
HnG	Hugo-Josephine complex, 50 to 75 percent slopes
HnG2	Hugo-Josephine complex, 50 to 75 percent slopes, eroded
HoG	Hugo-Laughlin complex, 30 to 75 percent slopes
HrG	Hugo-Los Gatos complex, 50 to 75 percent slopes
HsF	Hugo-Hely complex, 30 to 50 percent slopes
HsG	Hugo-Hely complex, 50 to 75 percent slopes
HtA	Huichica loam, 0 to 2 percent slopes
HtC	Huichica loam, 2 to 9 percent slopes
HtD	Huichica loam, 9 to 15 percent slopes
HuB	Huichica loam, ponded, 0 to 5 percent slopes
HvC	Huichica loam, shallow, 0 to 9 percent slopes
HwB	Huichica loam, shallow, ponded, 0 to 5 percent slopes
HyG	Huse stony clay loam, 30 to 75 percent slopes
JoE	Josephine loam, 9 to 30 percent slopes
JoF	Josephine loam, 30 to 50 percent slopes
JoF2	Josephine loam, 30 to 50 percent slopes, eroded
JoG	Josephine loam, 50 to 75 percent slopes
JsG	Josephine-Sites loams, 30 to 75 percent slopes
KdF	Kidd gravelly loam, 9 to 50 percent slopes
KeE	Kidd stony loam, 2 to 30 percent slopes
KkG	Kidd very rocky loam, 30 to 75 percent slopes
KlD	Kinman loam, 5 to 15 percent slopes
KlE	Kinman loam, 15 to 30 percent slopes
KlF	Kinman loam, 30 to 50 percent slopes
KmF	Kinman-Kneeland loams, 30 to 50 percent slopes
KnC	Kneeland loam, 5 to 9 percent slopes
KnD	Kneeland loam, 9 to 15 percent slopes
KnE	Kneeland loam, 15 to 30 percent slopes
KnF	Kneeland loam, 30 to 50 percent slopes
KoG	Kneeland rocky complex, 30 to 75 percent slopes
KsD	Kneeland sandy loam, sandy variant, 2 to 15 percent slopes
KsE	Kneeland sandy loam, sandy variant, 15 to 30 percent slopes
KvE	Kneeland rocky sandy loam, sandy variant, 9 to 30 percent slopes
LaC	Laniger loam, 5 to 9 percent slopes
LaD	Laniger loam, 9 to 15 percent slopes
LaE	Laniger loam, 15 to 30 percent slopes
LaE2	Laniger loam, 15 to 30 percent slopes, eroded
LaF	Laniger loam, 30 to 50 percent slopes
LgE	Laughlin loam, 2 to 30 percent slopes
LgF	Laughlin loam, 30 to 50 percent slopes
LgG	Laughlin loam, 50 to 75 percent slopes
LgG2	Laughlin loam, 50 to 75 percent slopes, eroded
LhG	Laughlin-Yorkville complex, 30 to 75 percent slopes
LkG	Los Gatos loam, 30 to 75 percent slopes
LmG	Los Gatos gravelly loam, 30 to 75 percent slopes
LnG	Los Gatos-Josephine complex, 30 to 75 percent slopes
LoD	Los Osos clay loam, 2 to 15 percent slopes
LoE	Los Osos clay loam, 15 to 30 percent slopes
LoF	Los Osos clay loam, 30 to 50 percent slopes
LoF2	Los Osos clay loam, 30 to 50 percent slopes, eroded
LsD	Los Osos clay loam, thin solum, 5 to 15 percent slopes
LsE	Los Osos clay loam, thin solum, 15 to 30 percent slopes
LsE2	Los Osos clay loam, thin solum, 15 to 30 percent slopes, eroded
LsF2	Los Osos clay loam, thin solum, 30 to 50 percent slopes, eroded
LuA	Los Robles gravelly clay loam, 0 to 2 percent slopes
LvB	Los Robles gravelly clay loam, moderately deep, 0 to 5 percent slopes
MbC	Manzanita gravelly silt loam, 0 to 9 percent slopes
McF	Maymen gravelly sandy loam, 30 to 50 percent slopes
MlG	Maymen-Los Gatos complex, 30 to 75 percent slopes
MmE	Mendocino sandy clay loam, 9 to 30 percent slopes
MmF	Mendocino sandy clay loam, 30 to 50 percent slopes
MnF	Mendocino-Empire complex, 0 to 50 percent slopes
MoE	Montara cobbly clay loam, 2 to 30 percent slopes
MoG	Montara cobbly clay loam, 30 to 75 percent slopes
NoD	Noyo coarse sandy loam, 0 to 15 percent slopes
PaA	Pajaro fine sandy loam, 0 to 2 percent slopes
PaB	Pajaro fine sandy loam, 2 to 5 percent slopes
PbB	Pajaro gravelly loam, 0 to 5 percent slopes
PcA	Pajaro clay loam, overwash, 0 to 2 percent slopes
PcB	Pajaro clay loam, overwash, 2 to 5 percent slopes
PeA	Pleasanton loam, 0 to 2 percent slopes
PeC	Pleasanton loam, 2 to 9 percent slopes
PgB	Pleasanton gravelly loam, 2 to 5 percent slopes
PhB	Pleasanton clay loam, 2 to 5 percent slopes
PkC	Pleasanton gravelly clay loam, 2 to 9 percent slopes
PlC	Pleasanton-Haire complex, 0 to 9 percent slopes
PlD	Pleasanton-Haire complex, 9 to 15 percent slopes
PsC	Positas gravelly loam, 0 to 9 percent slopes
PsD	Positas gravelly loam, 9 to 15 percent slopes
RaC	Raynor clay, 2 to 9 percent slopes
RaD	Raynor clay, 9 to 15 percent slopes
RaE	Raynor clay, 15 to 30 percent slopes
RcD	Raynor clay, seeped, 2 to 15 percent slopes
ReE	Raynor-Montara complex, 0 to 30 percent slopes
RhD	Red Hill clay loam, 2 to 15 percent slopes
RhE	Red Hill clay loam, 15 to 30 percent slopes
RhF	Red Hill clay loam, 30 to 50 percent slopes
RlG	Red Hill cobbly clay loam, 30 to 75 percent slopes
RmA	Reyes silty clay, 0 to 2 percent slopes
RnA	Riverwash
RoG	Rock land
RrC	Rohnerville loam, 0 to 9 percent slopes
RrD	Rohnerville loam, 9 to 15 percent slopes
SbC	Sebastopol sandy loam, 2 to 9 percent slopes
SbD	Sebastopol sandy loam, 9 to 15 percent slopes
SbD2	Sebastopol sandy loam, 9 to 15 percent slopes, eroded
SbE	Sebastopol sandy loam, 15 to 30 percent slopes
SeE	Sheridan coarse sandy loam, 2 to 30 percent slopes
SfE	Sites loam, 5 to 30 percent slopes
SfF	Sites loam, 30 to 50 percent slopes
ShE	Sobrante loam, 15 to 30 percent slopes
ShF	Sobrante loam, 30 to 50 percent slopes
ShG	Sobrante loam, 50 to 75 percent slopes
SkC	Spreckels loam, 2 to 9 percent slopes
SkD	Spreckels loam, 9 to 15 percent slopes
SkE	Spreckels loam, 15 to 30 percent slopes
SkE2	Spreckels loam, 15 to 30 percent slopes, eroded
SkF	Spreckels loam, 30 to 50 percent slopes
SnC	Steinbeck loam, 2 to 9 percent slopes
SnD	Steinbeck loam, 9 to 15 percent slopes
SnD2	Steinbeck loam, 9 to 15 percent slopes, eroded
SnE	Steinbeck loam, 15 to 30 percent slopes
SnE2	Steinbeck loam, 15 to 30 percent slopes, eroded
SnF	Steinbeck loam, 30 to 50 percent slopes
SnF2	Steinbeck loam, 30 to 50 percent slopes, eroded
SoF	Stonyford gravelly loam, 30 to 50 percent slopes
SoG	Stonyford gravelly loam, 50 to 75 percent slopes
SrG	Stonyford-Broomer complex, 30 to 75 percent slopes
SsG	Supan silt loam, 30 to 75 percent slopes
StE	Suther loam, 15 to 30 percent slopes
StE2	Suther loam, 15 to 30 percent slopes, eroded
StF	Suther loam, 30 to 50 percent slopes
SuF	Suther-Laughlin loams, 15 to 50 percent slopes
SuG	Suther-Laughlin loams, 50 to 75 percent slopes
TeG	Terrace escarpments
TmA	Tidal marsh
ToE	Toomes rocky loam, 2 to 30 percent slopes
ToG	Toomes rocky loam, 30 to 75 percent slopes
TuC	Tuscan cobbly clay loam, 0 to 9 percent slopes
TuE	Tuscan cobbly clay loam, 9 to 30 percent slopes
WgC	Wright loam, 0 to 9 percent slopes
WhA	Wright loam, wet, 0 to 2 percent slopes
WmB	Wright loam, shallow, 0 to 5 percent slopes
WoA	Wright loam, shallow, wet, 0 to 2 percent slopes
YlA	Yolo sandy loam, 0 to 2 percent slopes
YmB	Yolo sandy loam, overwash, 0 to 5 percent slopes
YnA	Yolo loam, 0 to 2 percent slopes
YoB	Yolo loam, overwash, 0 to 5 percent slopes
YrB	Yolo gravelly loam, 0 to 5 percent slopes
YsA	Yolo silt loam, 0 to 2 percent slopes
YtA	Yolo clay loam, 0 to 2 percent slopes
YuE	Yorkville clay loam, 5 to 30 percent slopes
YuF	Yorkville clay loam, 30 to 50 percent slopes
YvF	Yorkville-Laughlin complex, 30 to 50 percent slopes
YwF	Yorkville-Suther complex, 0 to 50 percent slopes
YwG	Yorkville-Suther complex, 50 to 75 percent slopes
ZaA	Zamora silty clay loam, 0 to 2 percent slopes
ZaB	Zamora silty clay loam, 2 to 5 percent slopes

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 1

1

N



(Joins sheet 2)

(Joins sheet 9)

1 Mile
5000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000

SONOMA COUNTY, CALIFORNIA NO. 1

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.
Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 2

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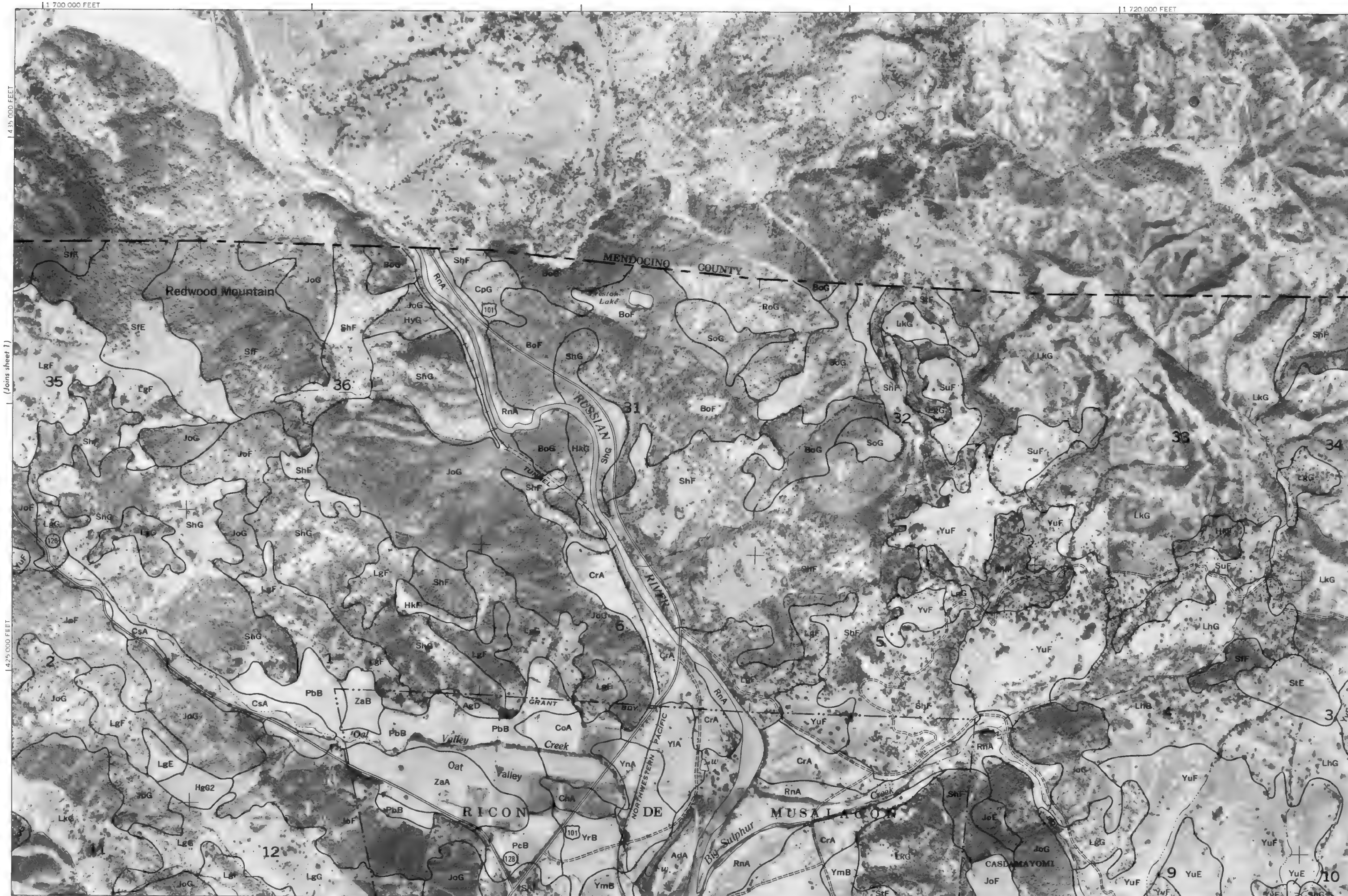

1 Mile
5000 Feet
Scale 1:20 000

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

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SONOMA COUNTY, CALIFORNIA NO. 2

SONOMA COUNTY, CALIFORNIA NO. 3

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Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

N

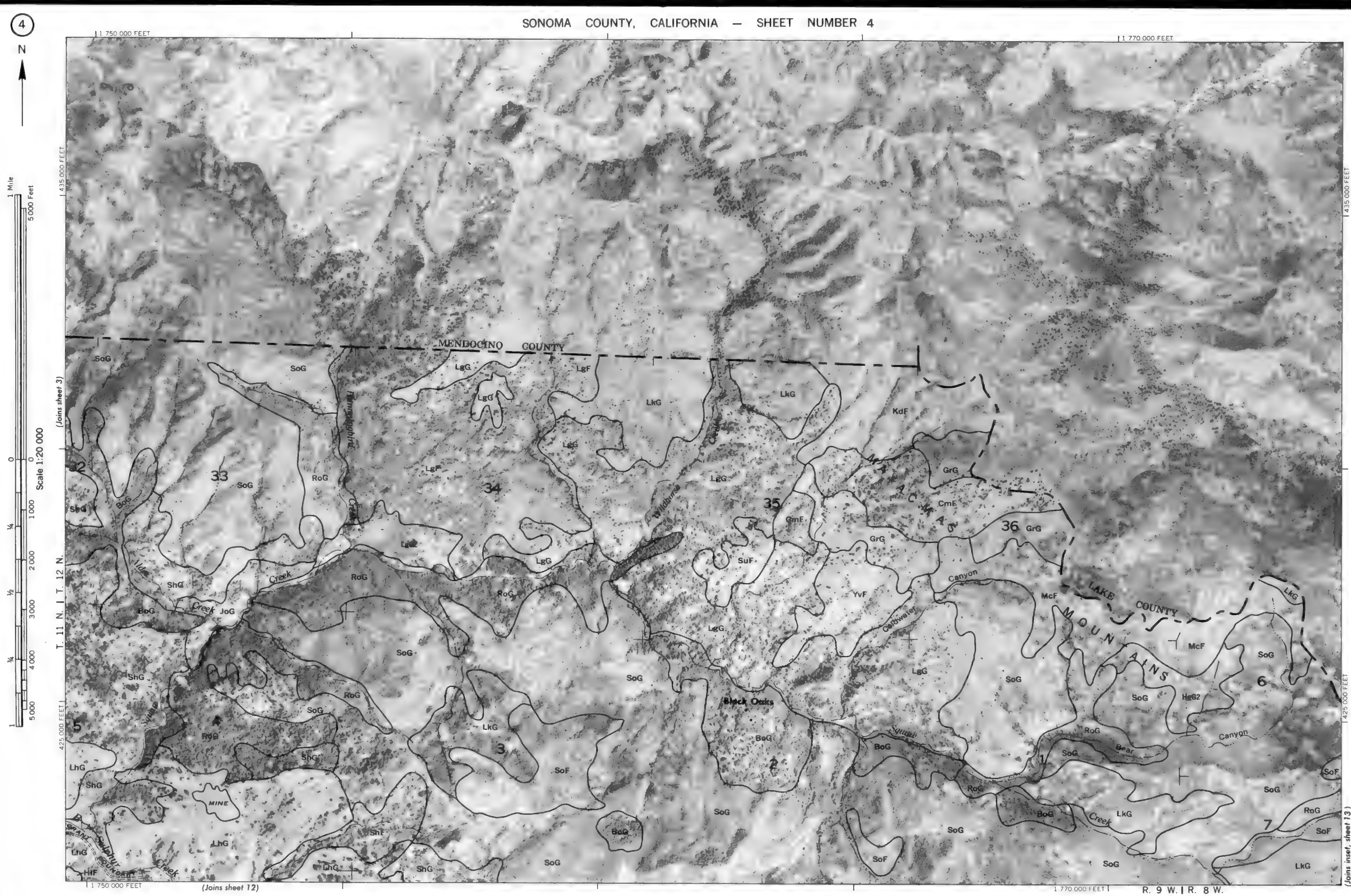
1 Mile

5000 Feet

Scale 1:20 000

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

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SONOMA COUNTY, CALIFORNIA NO. 4

5

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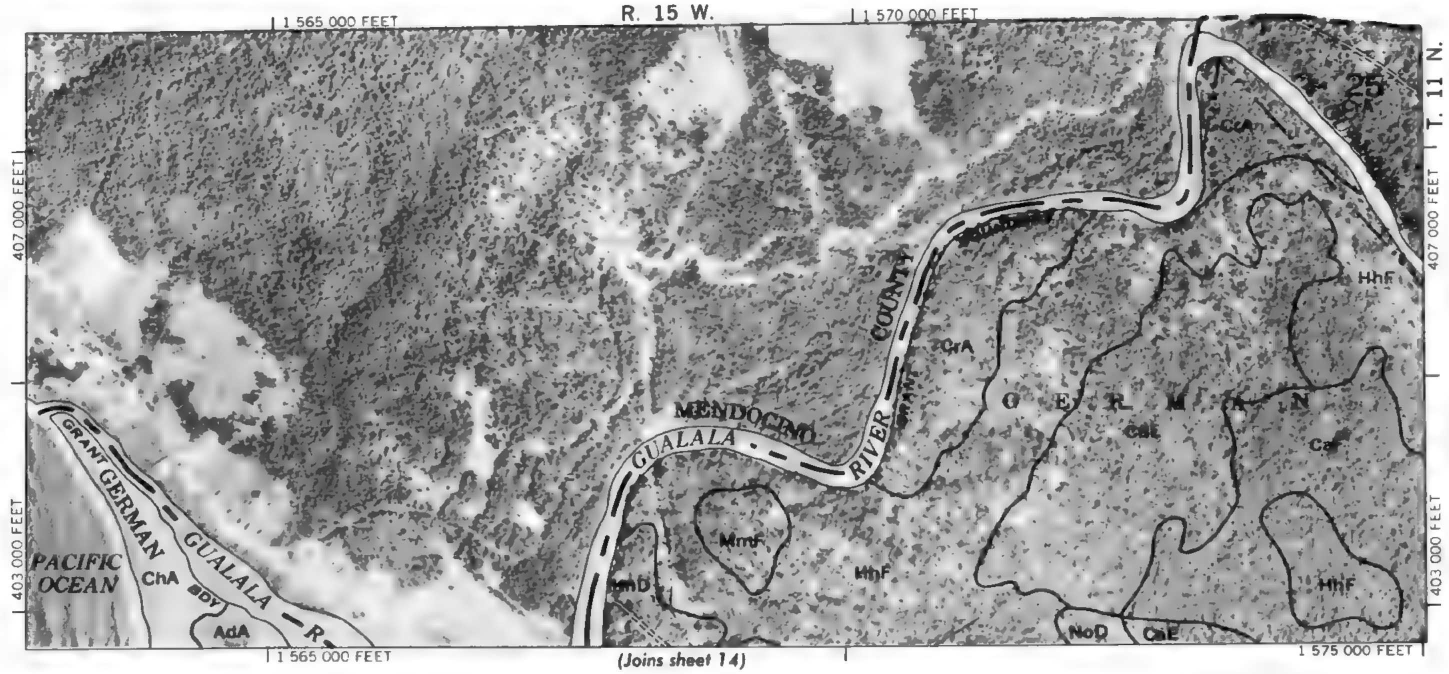

Scale 1:20 000

1 Mile

5000 Feet

SONOMA COUNTY, CALIFORNIA NO. 5

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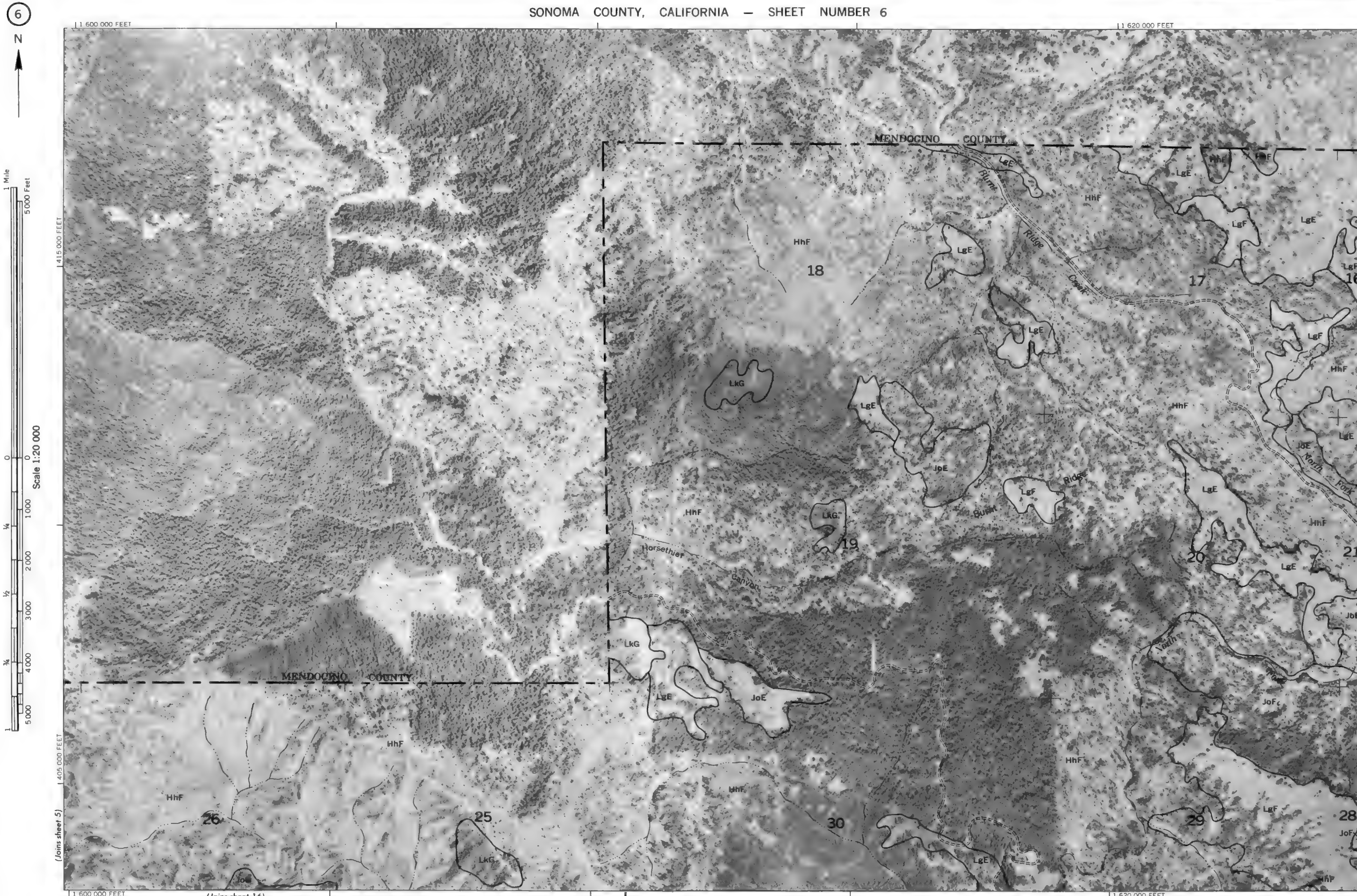
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.



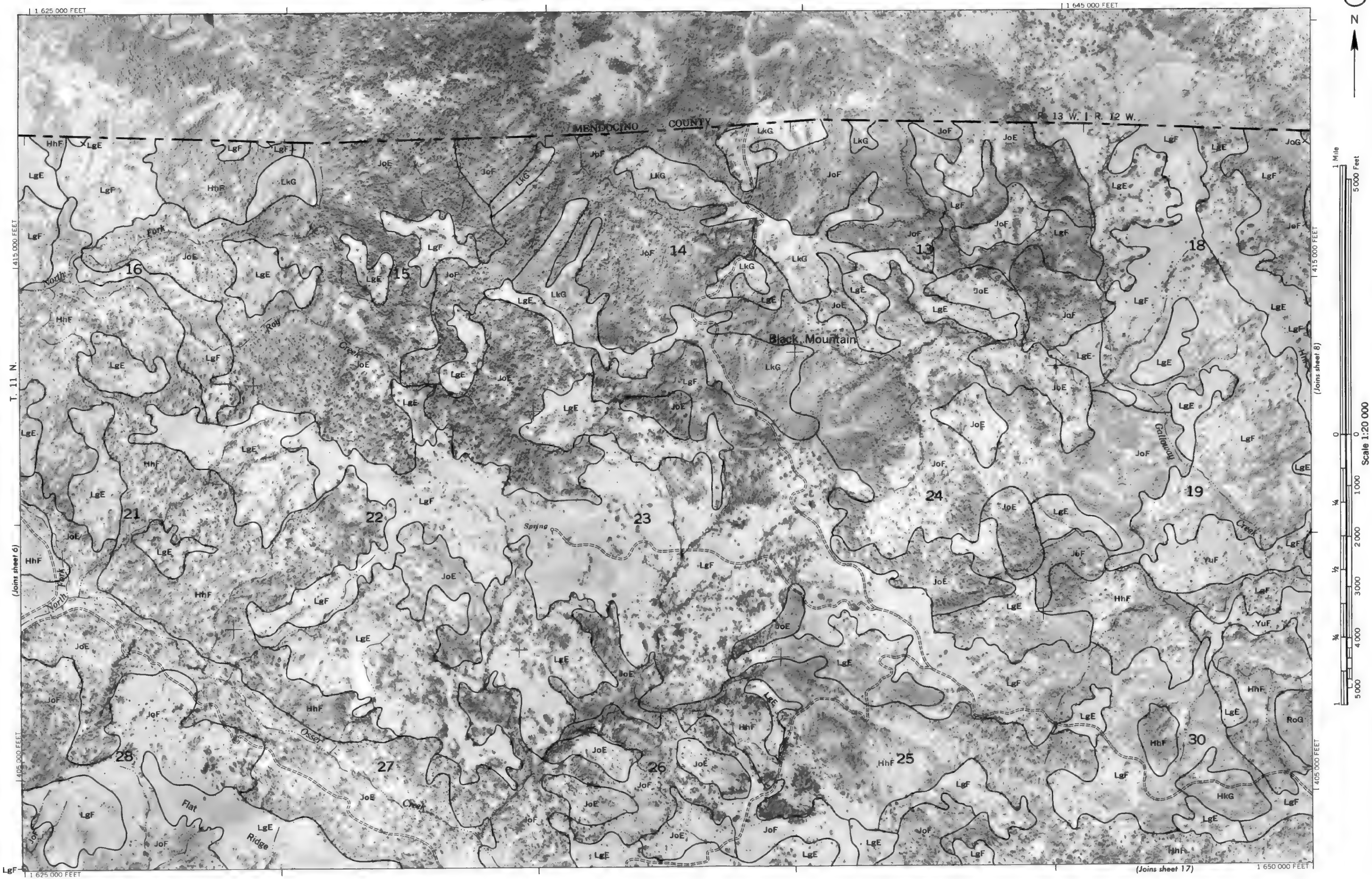
Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum.

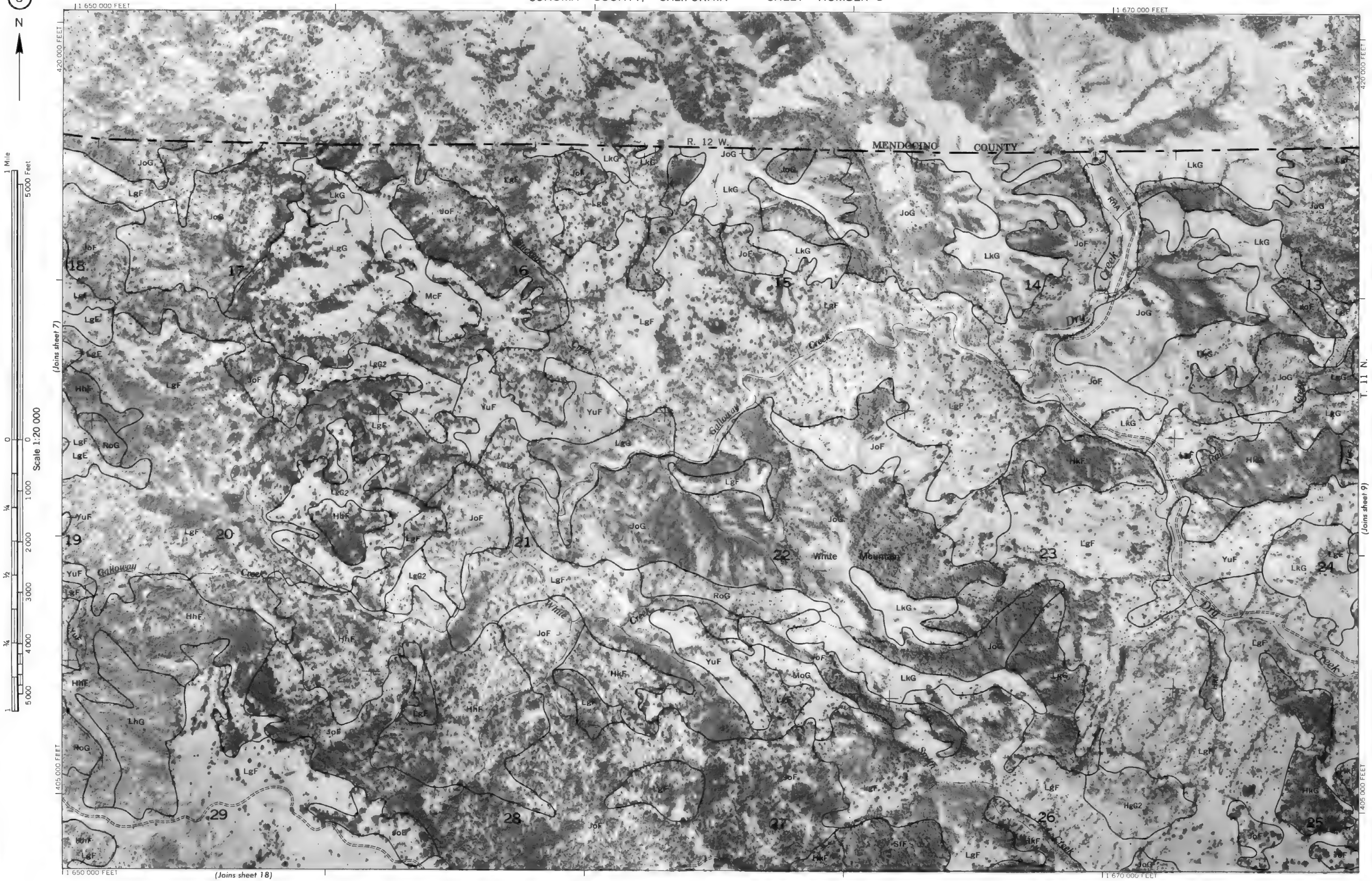
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 7

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2 1927 North American Datum.
Land division corners are approximately positioned on this map.



SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 8



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 9

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

R. 12 W. | R. 11 W.

N

1 Mile

5000 Feet

0

1000

¼

2000

½

3000

¾

4000

5000

1

Scale 1:20 000

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 10

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 100

(Joins sheet 92)

(Joins sheet 108)

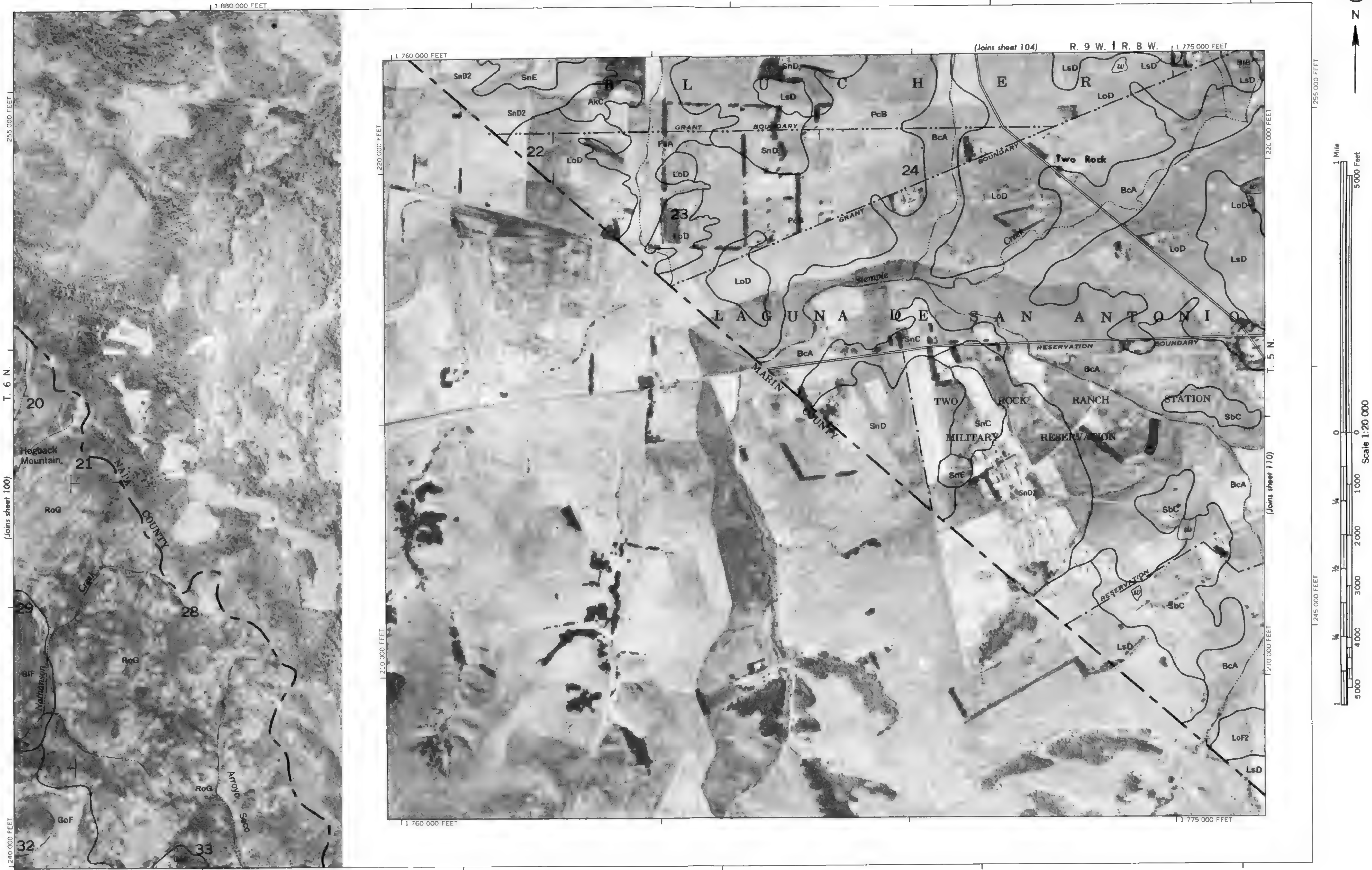
1 Mile
5 000 Feet
Scale 1:20 000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO.100

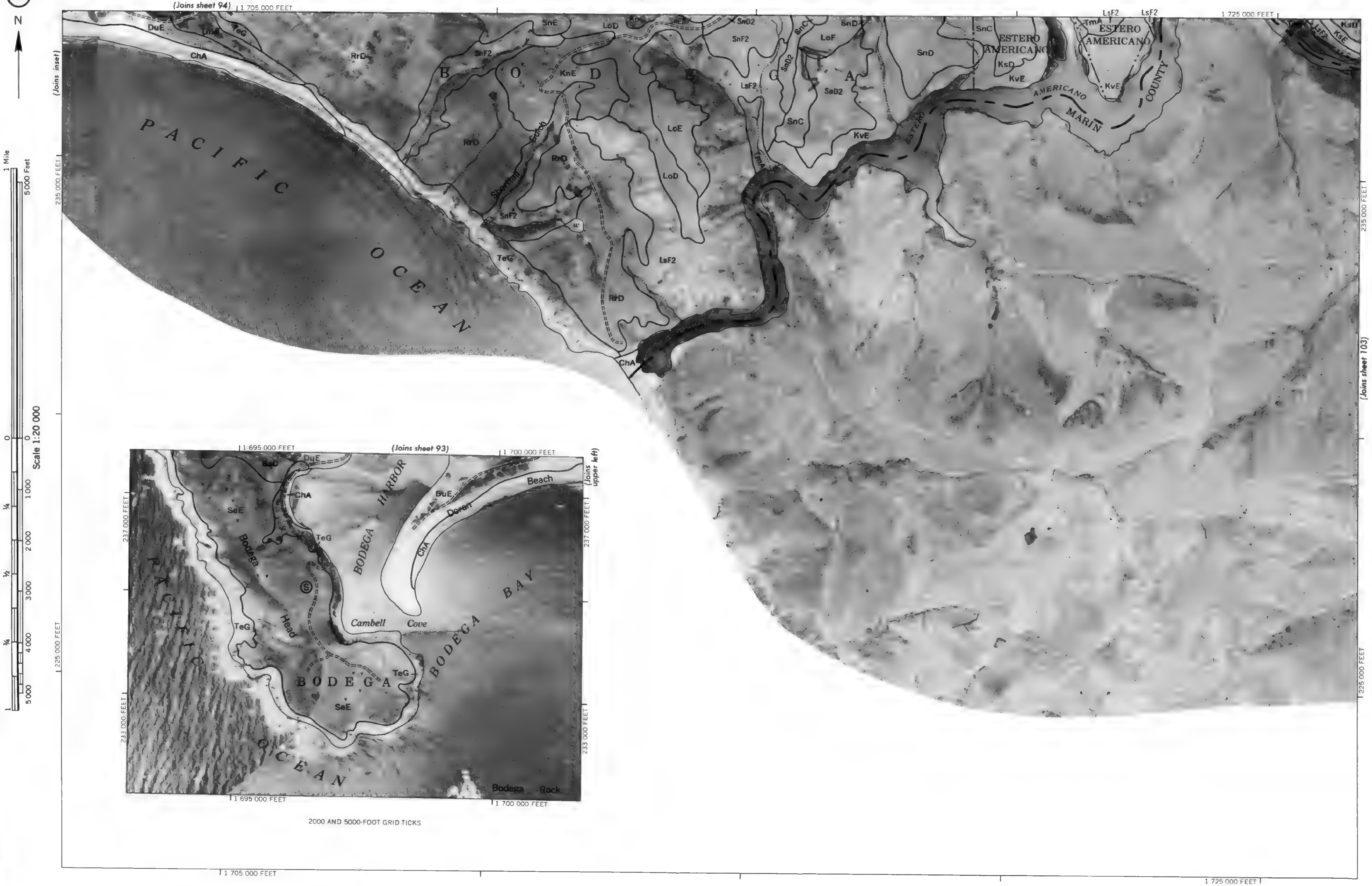


SONOMA COUNTY, CALIFORNIA NO.101

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

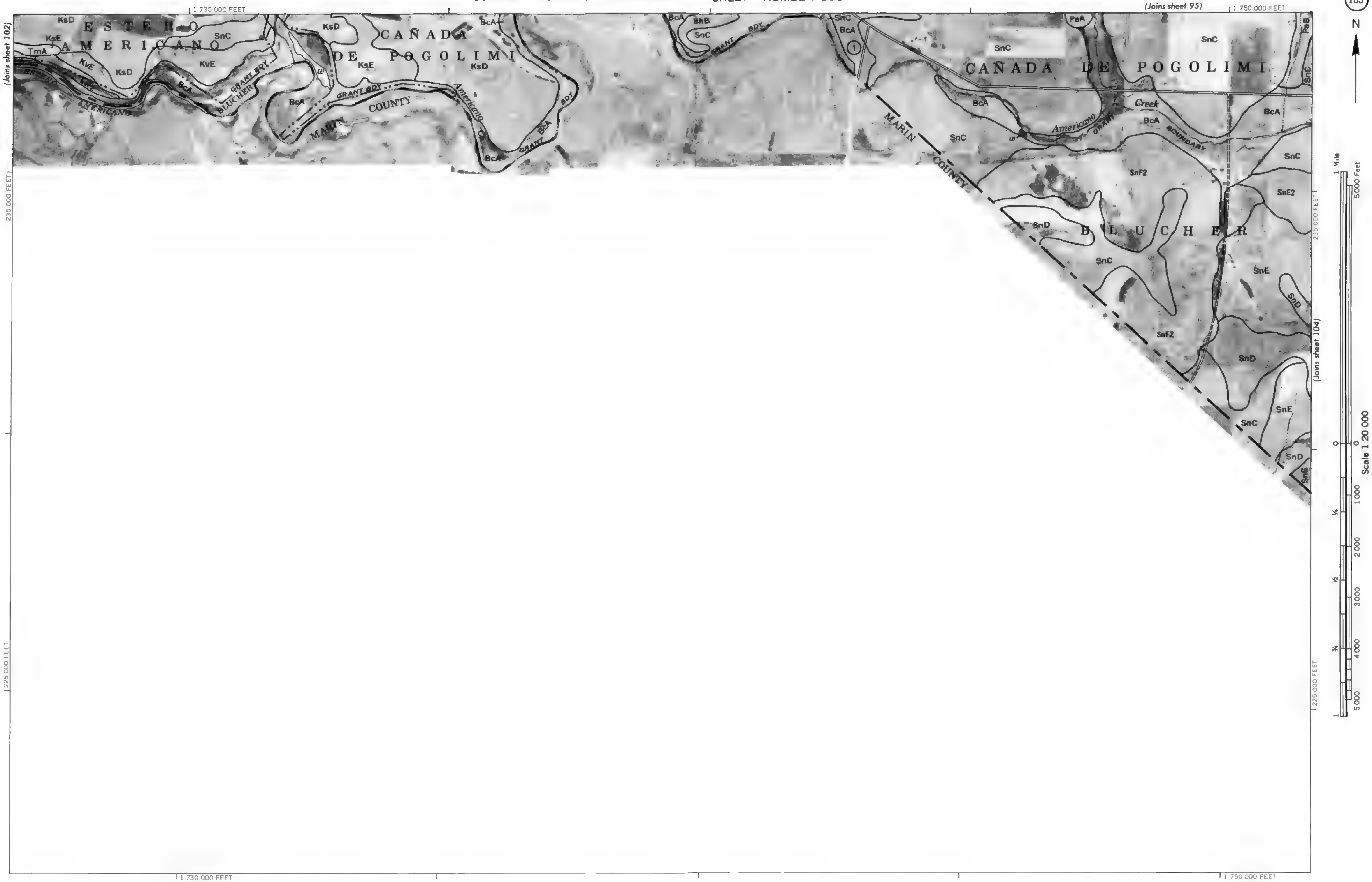
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

Land division corners are approximately positioned on this map.



Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

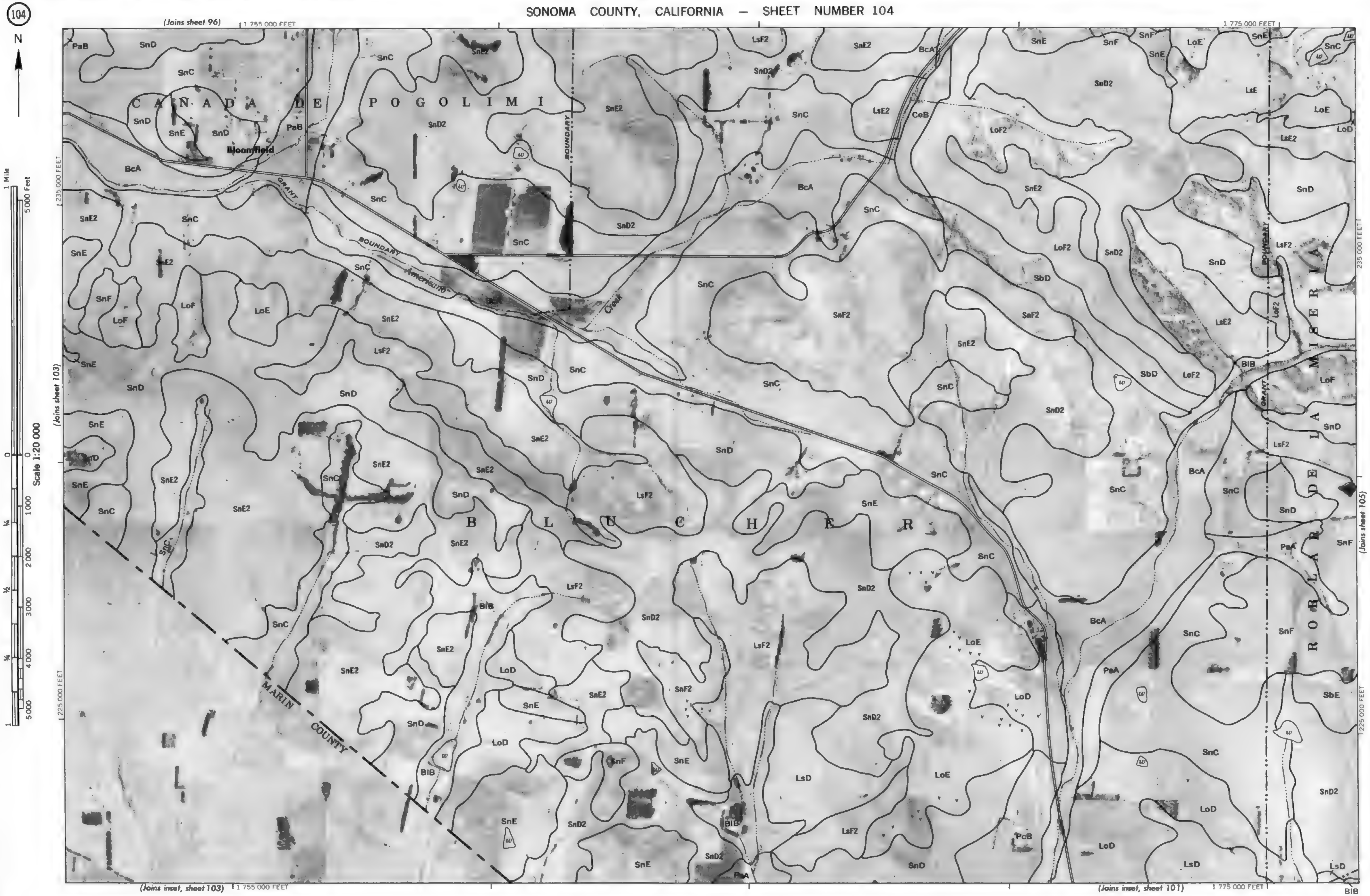


SONOMA COUNTY, CALIFORNIA NO. 103

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

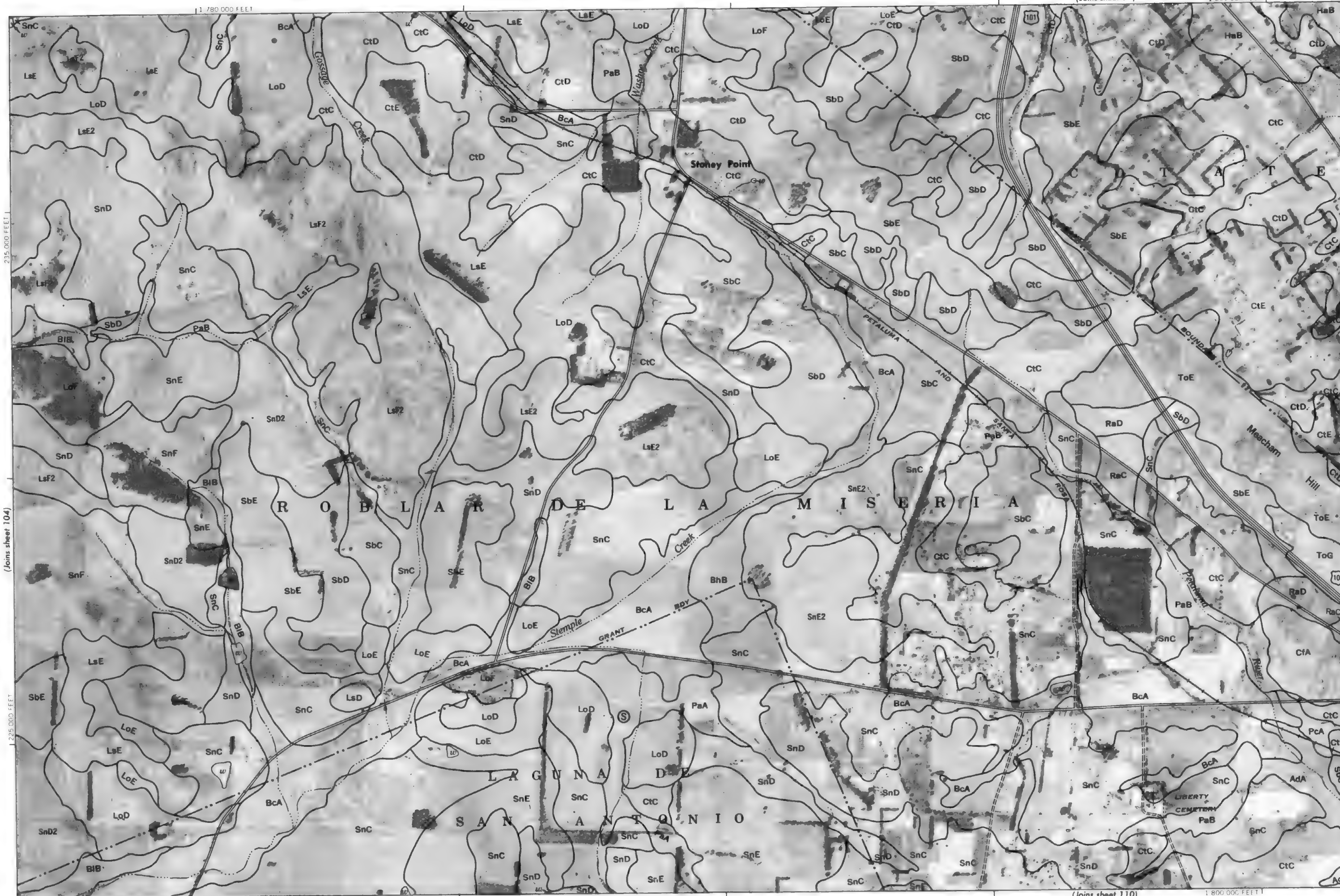
SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 104



Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 104

105



SONOMA COUNTY, CALIFORNIA NO.105

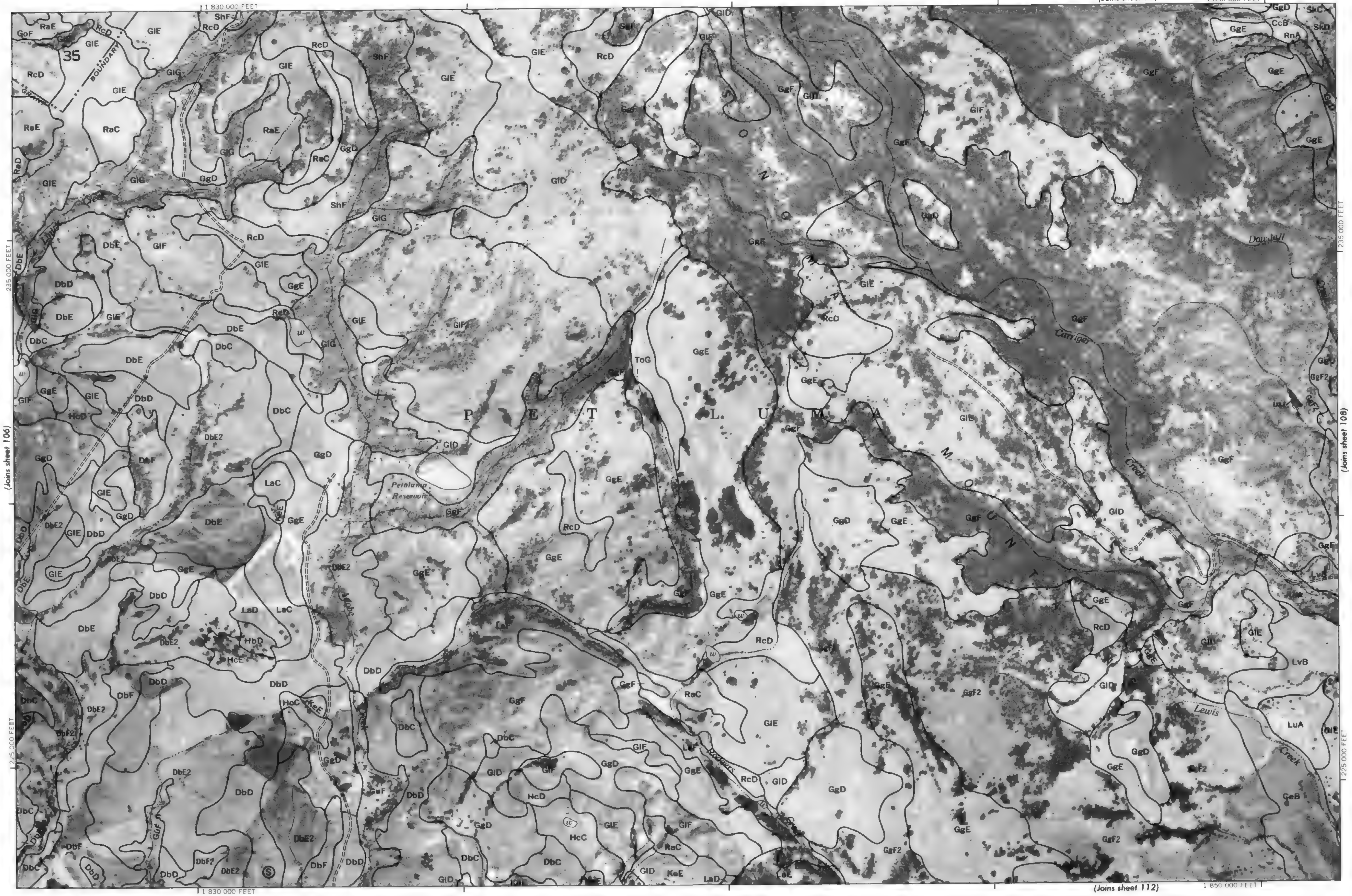
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 106

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.



1 Mile
5000 Feet
Scale 1:20 000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

SONOMA COUNTY, CALIFORNIA NO.107

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

108

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 108

N

Scale 1:20 000

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 108

SONOMA COUNTY, CALIFORNIA NO. 109

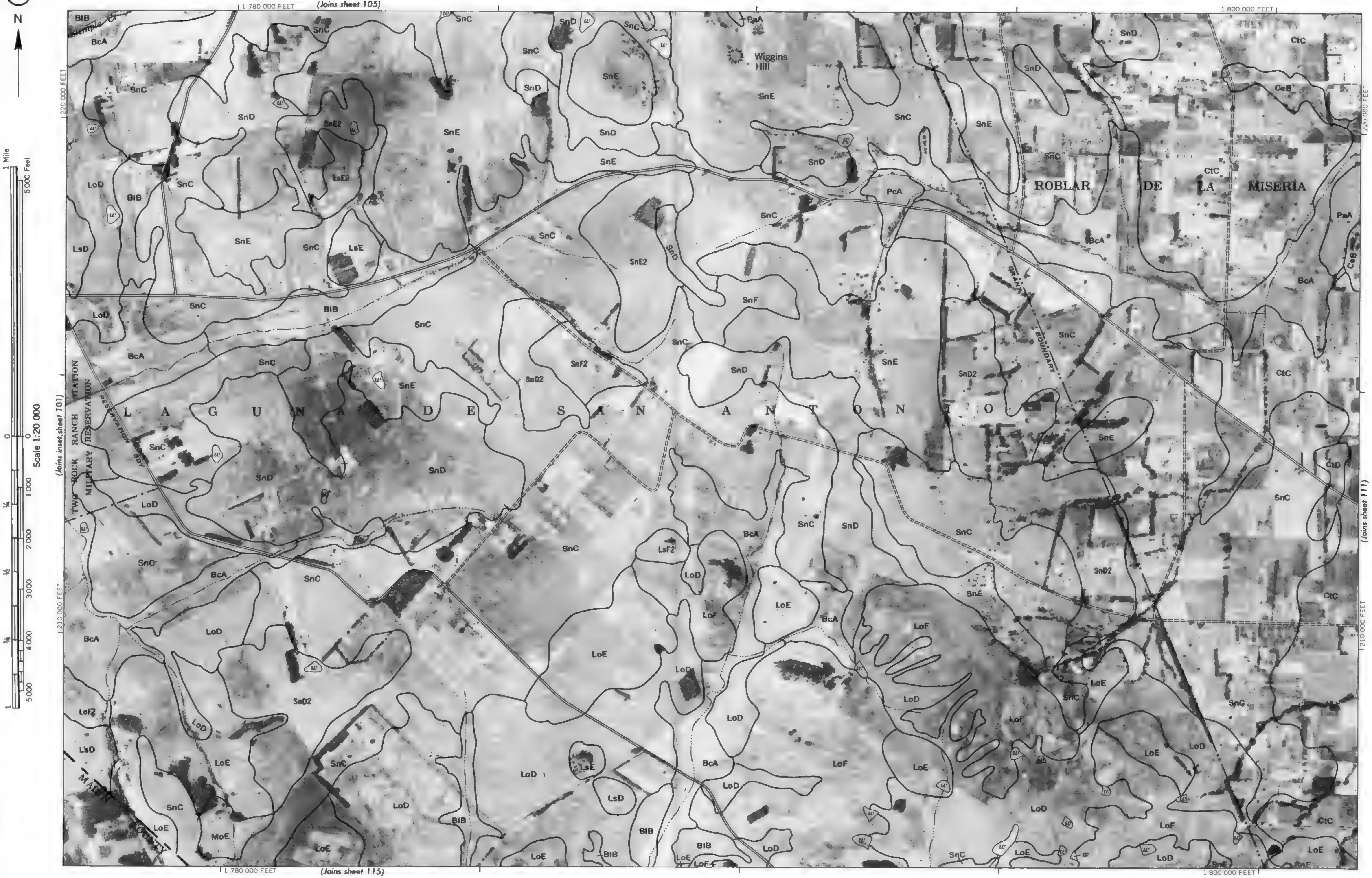
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA NO. 11
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.
Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 110



Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 110

111

SONOMA COUNTY, CALIFORNIA NO.111

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

Land division corners are approximately positioned on this map.

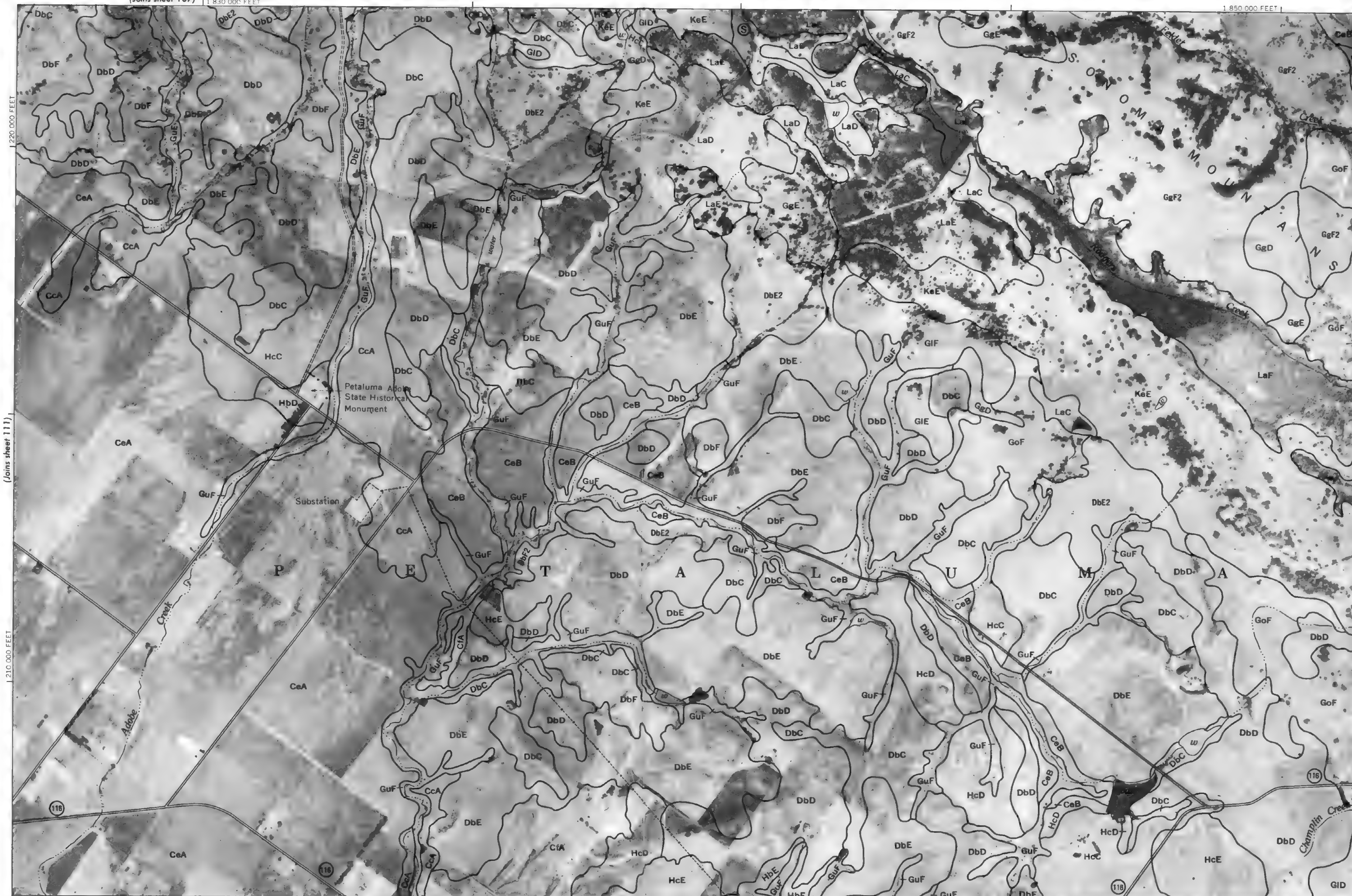
N

1 Mile
5000 Feet
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000
Scale 1:20 000

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 112

N

Scale 1:20 000



Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

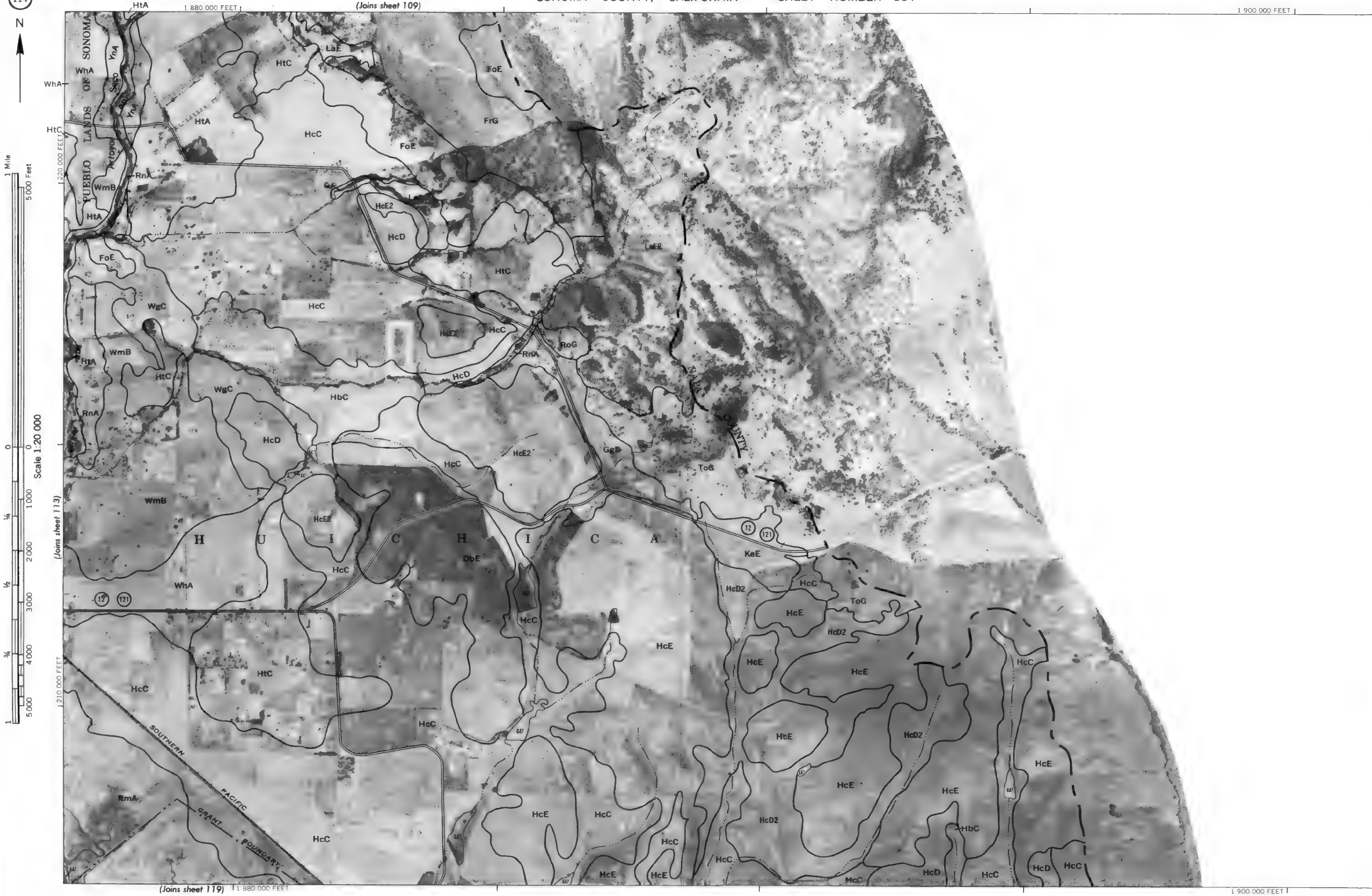
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO.112

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 113

SONOMA COUNTY, CALIFORNIA NO.113
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

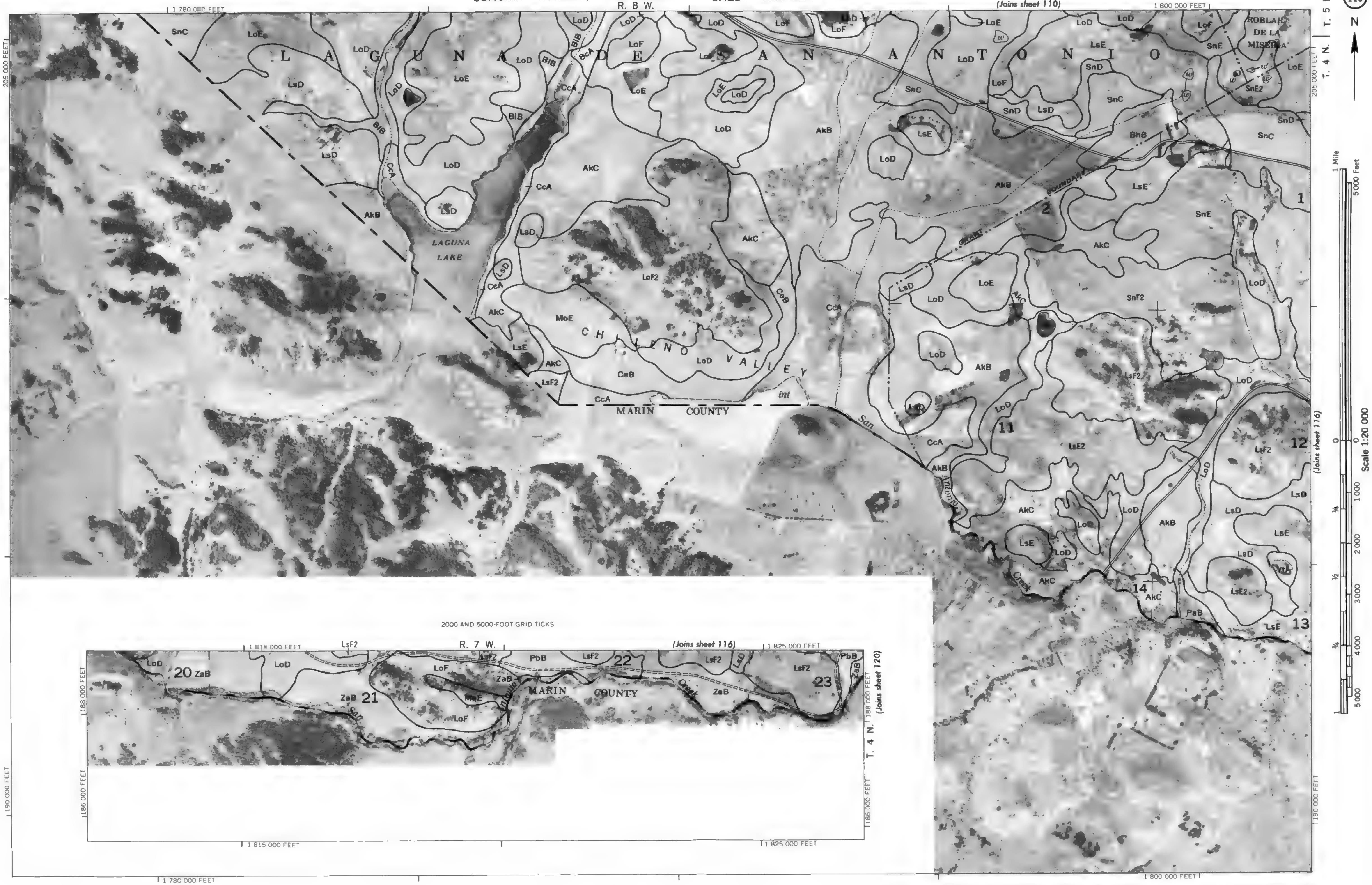
SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 114



SONOMA COUNTY, CALIFORNIA NO. 114

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station



SONOMA COUNTY, CALIFORNIA NO. 115

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum
Land division corners are approximately positioned on this map.

R. 8 W. | R. 7 W. (Joins sheet 111)

N

Scale 1:20 000
1 Mile
5000 Feet
0 1000 2000 3000 4000 5000
¼ ½ ¾ 1

(Joins sheet 115)

(Joins sheet 117)

T. 5 N. | T. 4 N.

205 000 FEET
190 000 FEET
1 805 000 FEET
1 825 000 FEET

(Joins inset, sheet 115)

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 116

SONOMA COUNTY, CALIFORNIA NO.117

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 118

SONOMA COUNTY, CALIFORNIA NO. 119

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

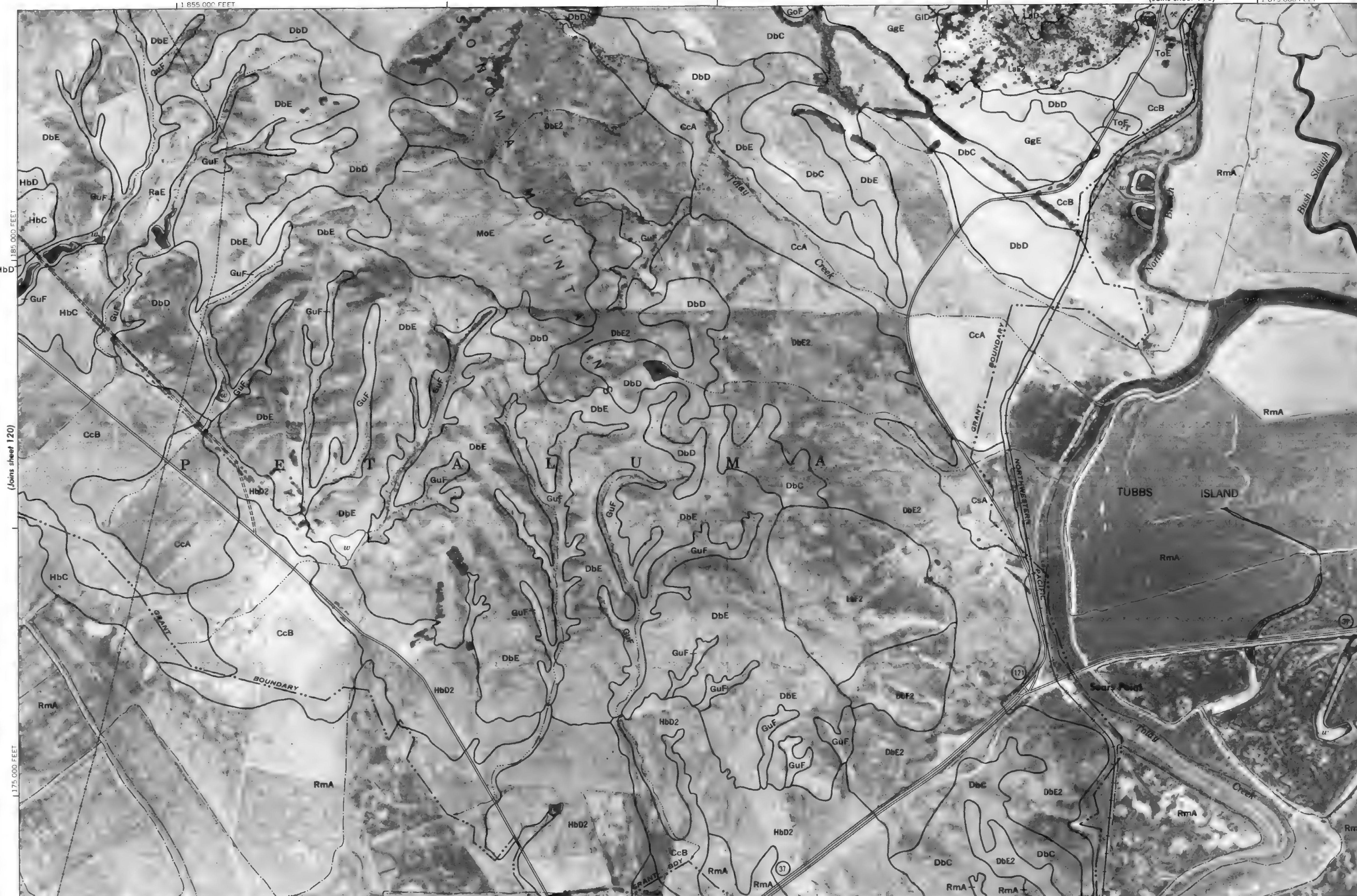
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 12

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 120

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

121



N

1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
0
¼
½
¾
1
Scale 1:20 000

SONOMA COUNTY, CALIFORNIA NO.121

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

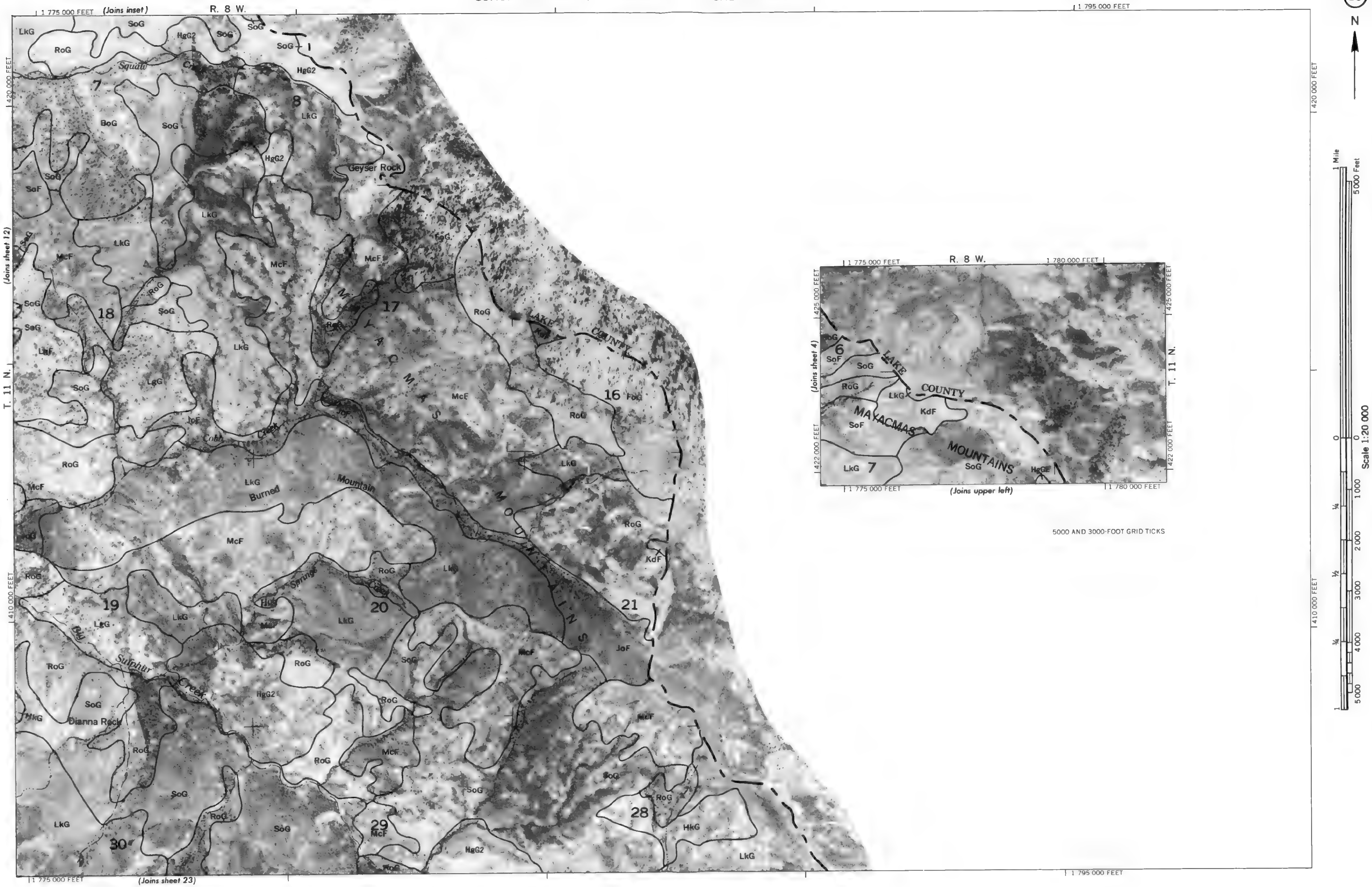
SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 122

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO.123

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum



SONOMA COUNTY, CALIFORNIA NO. 13

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

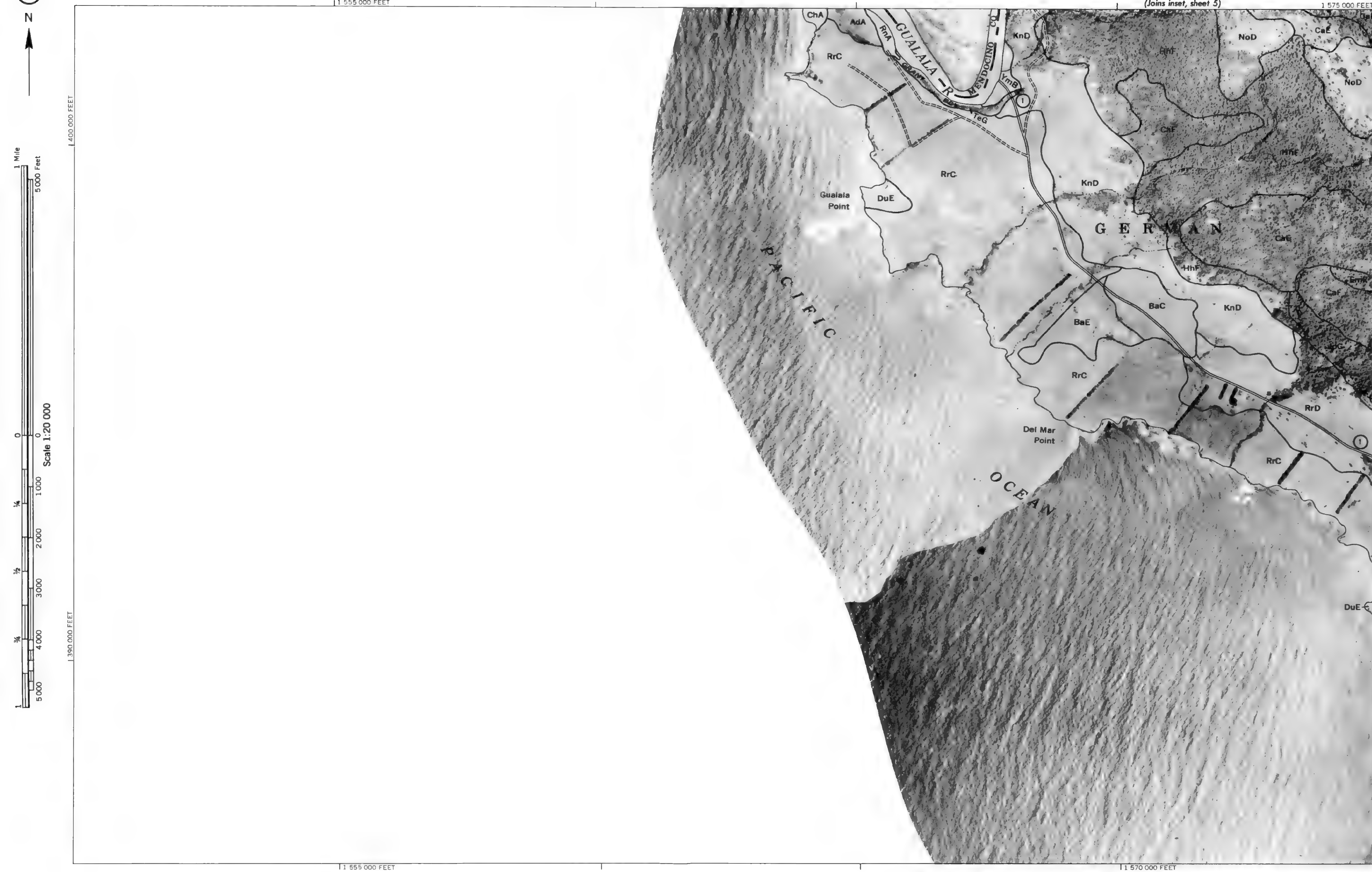
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

(14)

N

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 14



Scale 1:20 000

1 Mile

5 000 Feet

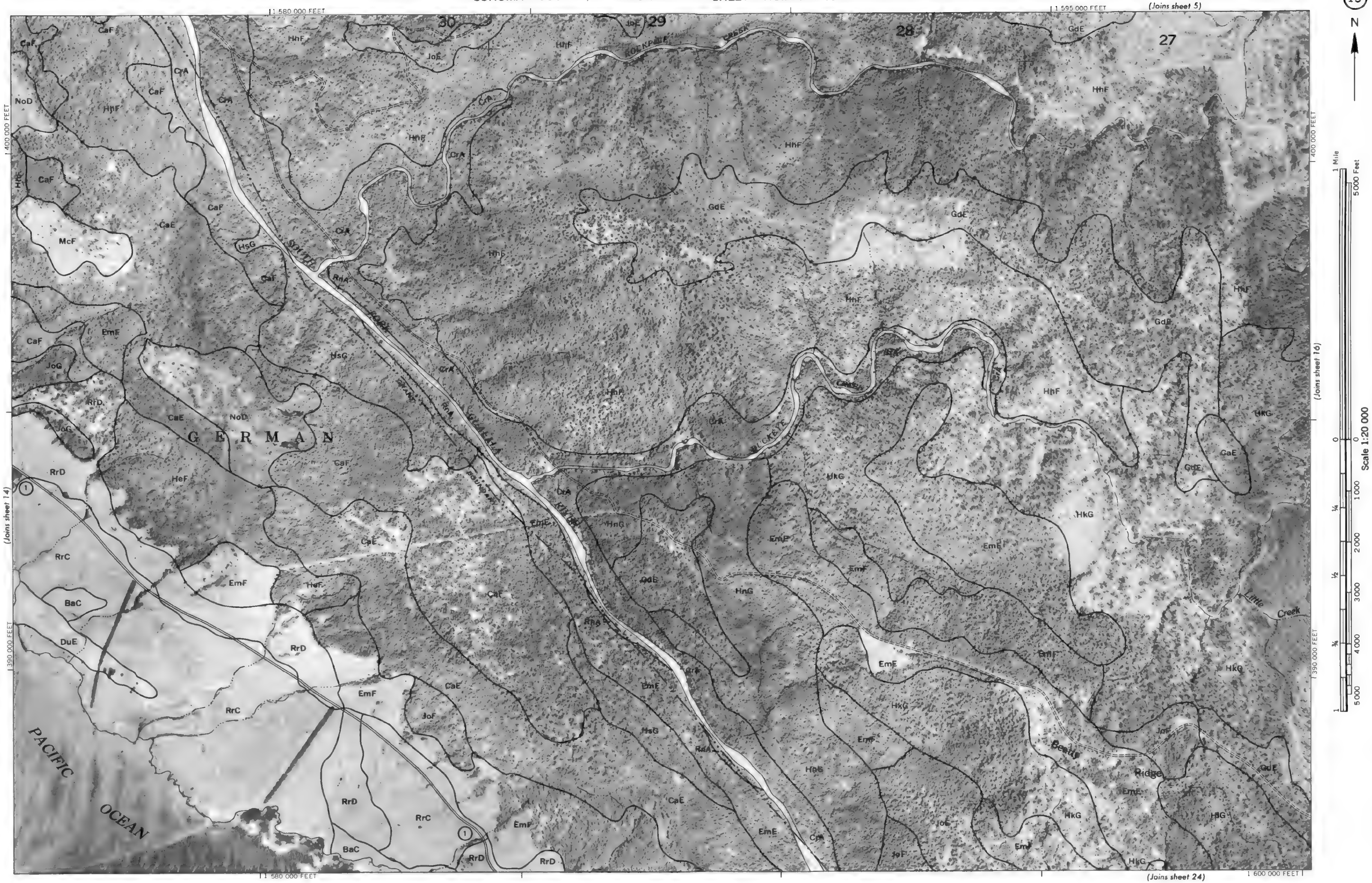
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 14

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 15

15



SONOMA COUNTY, CALIFORNIA NO. 15

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

N

1 Mile 5 000 Feet

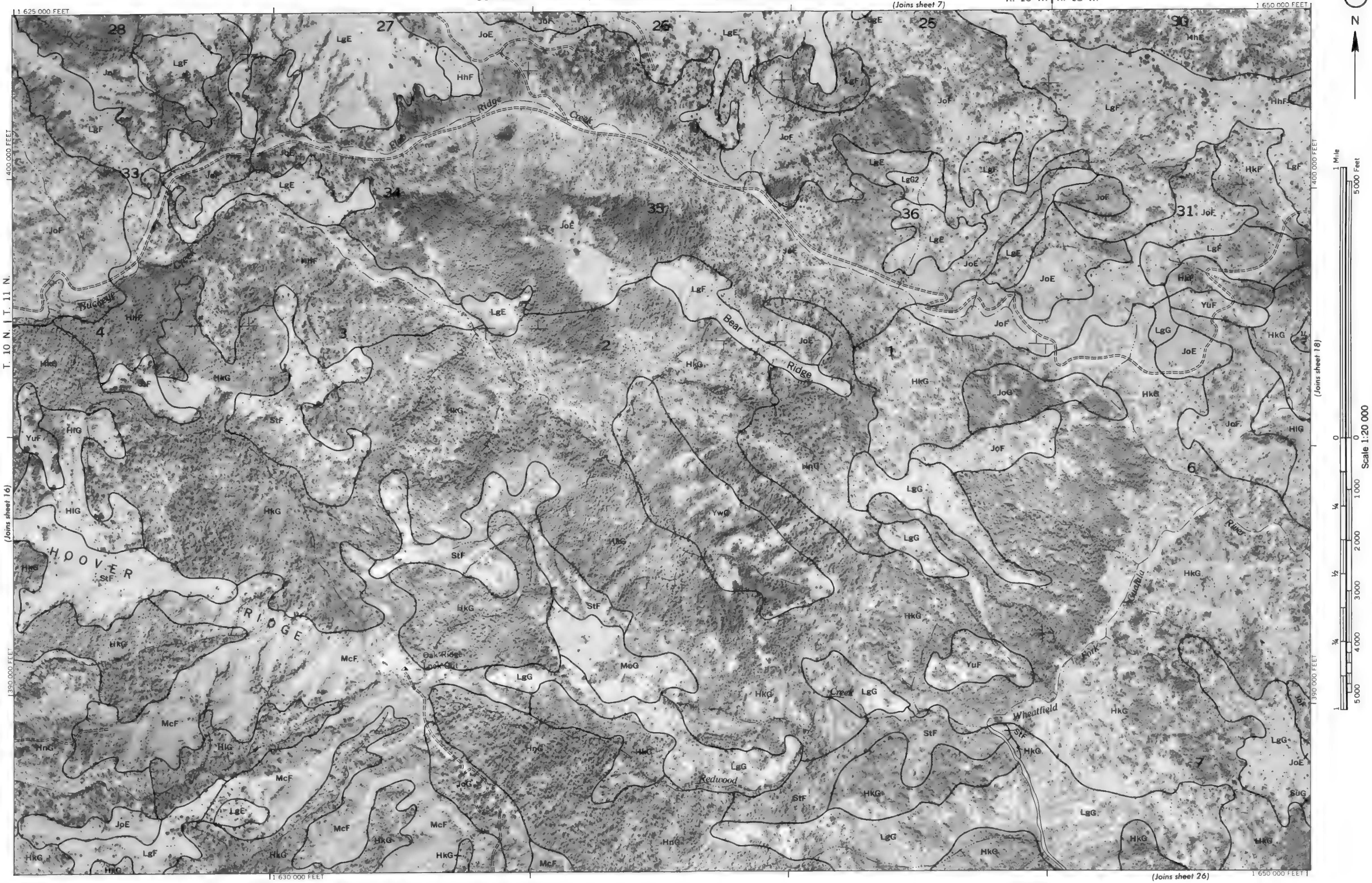
Scale 1:20 000

0 1000 2000 3000 4000 5000

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 17



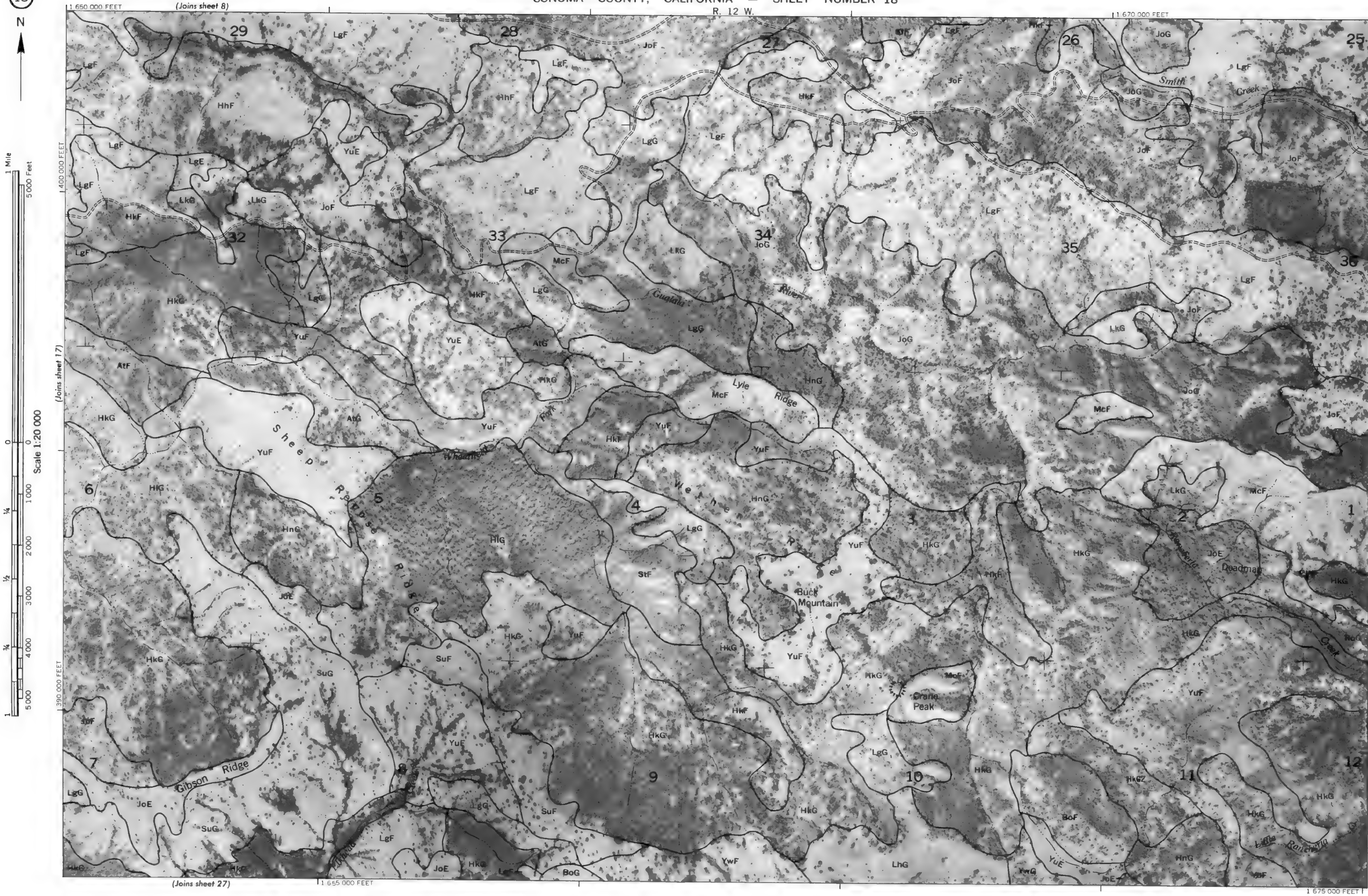
SONOMA COUNTY, CALIFORNIA NO. 17

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 18



Land division corners are approximately positioned on this map

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

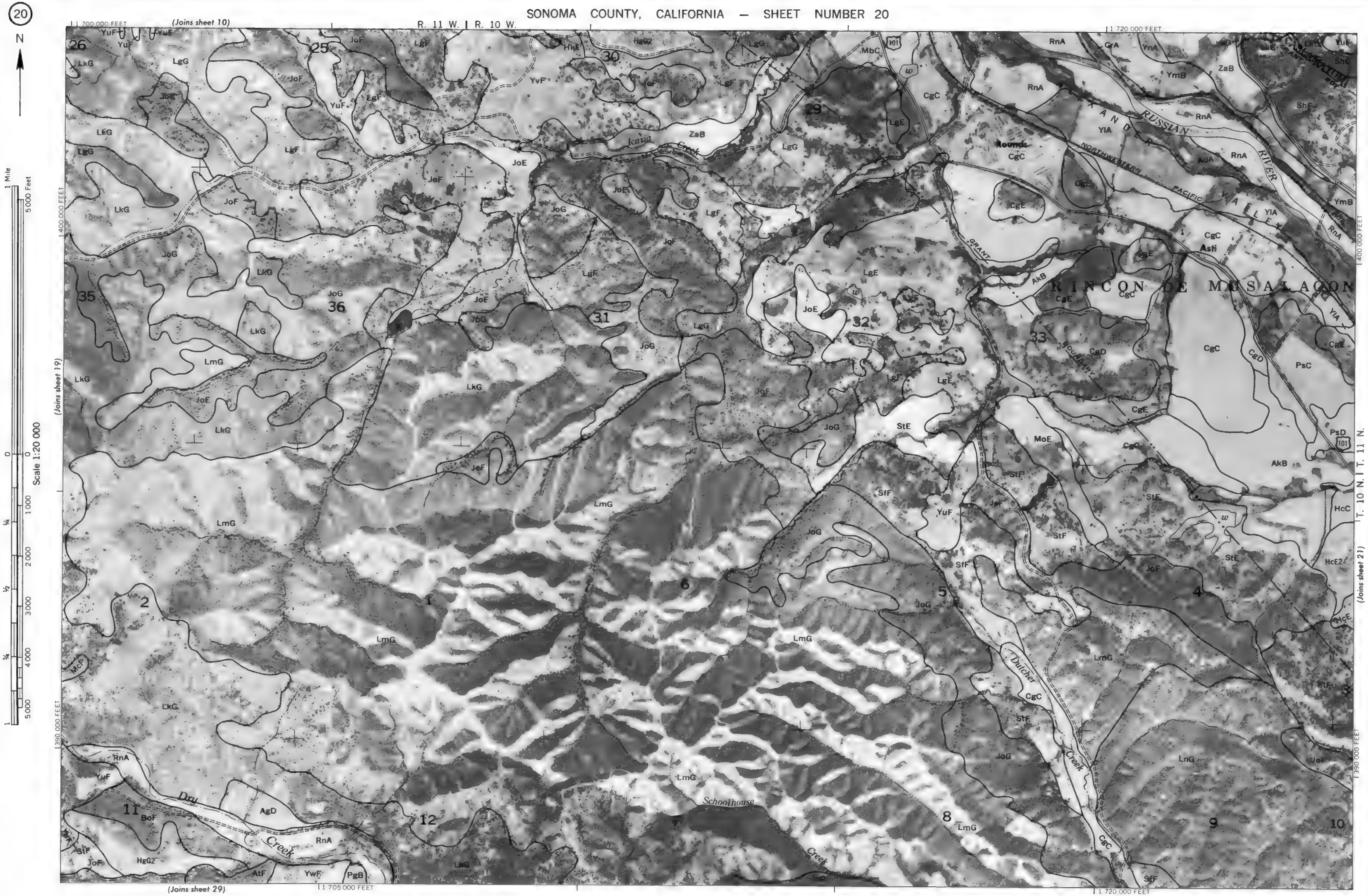
SONOMA COUNTY, CALIFORNIA NO. 18

SONOMA COUNTY, CALIFORNIA NO. 19

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

(21)

SONOMA COUNTY, CALIFORNIA NO. 21

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

N

Scale 1:20 000

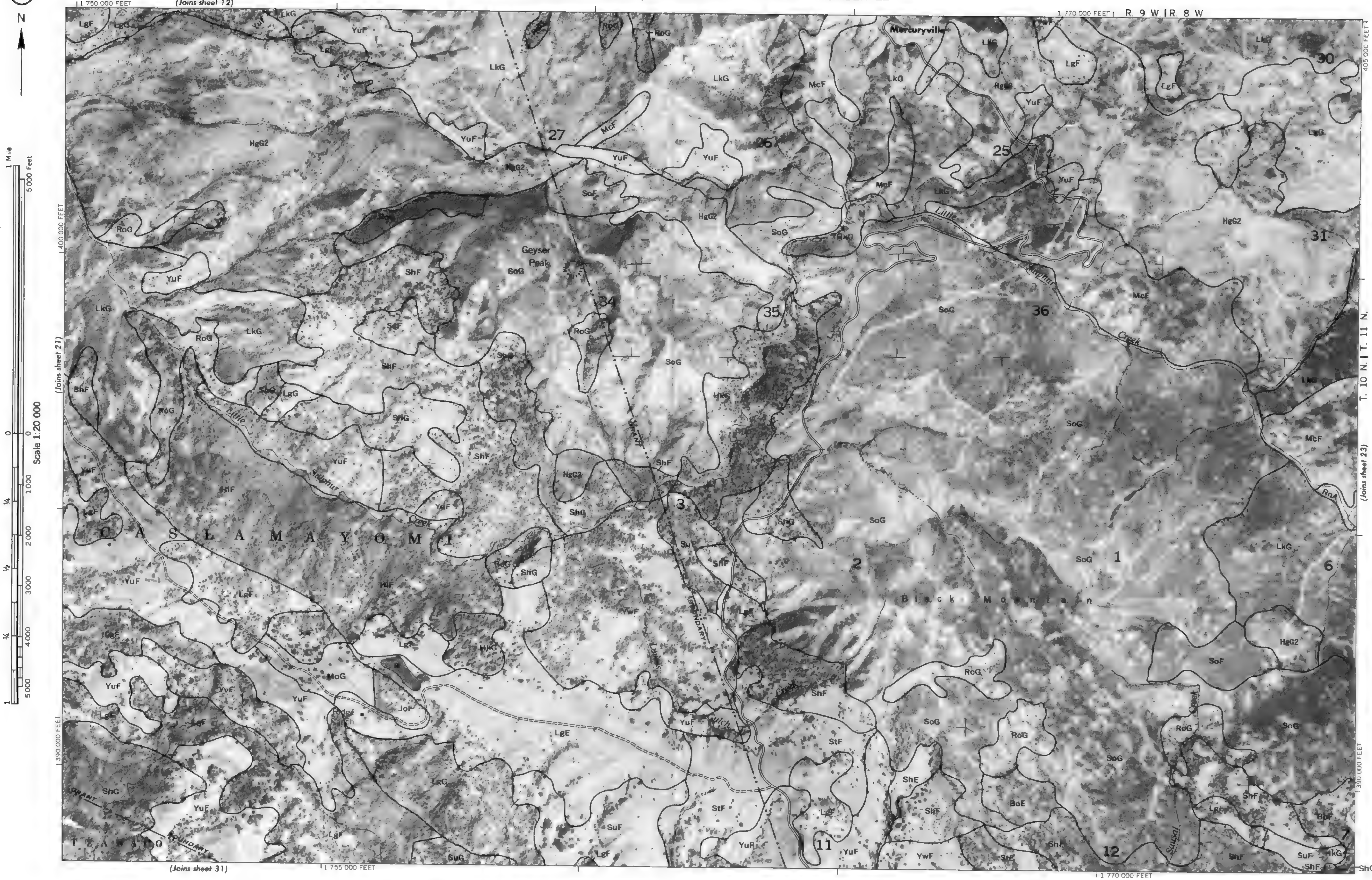
1 Mile

5 000 Feet

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 22



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 23

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 25

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

26

N

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 26

1 Mile
5 000 Feet
Scale 1:20 000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 26

SONOMA COUNTY, CALIFORNIA NO. 27

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 28

N

Scale 1:20 000

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

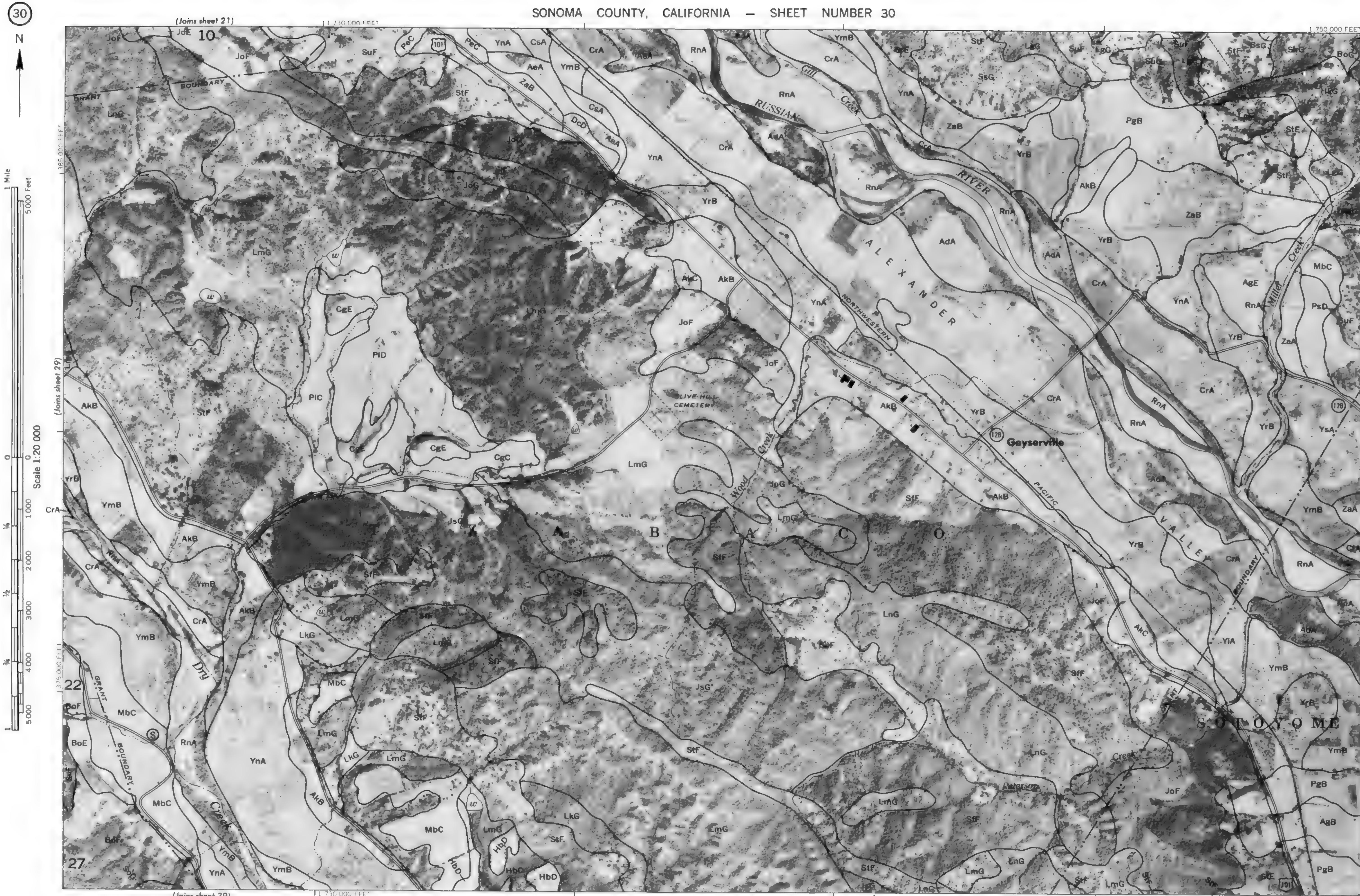
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 29

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 30

SONOMA COUNTY, CALIFORNIA NO. 31

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

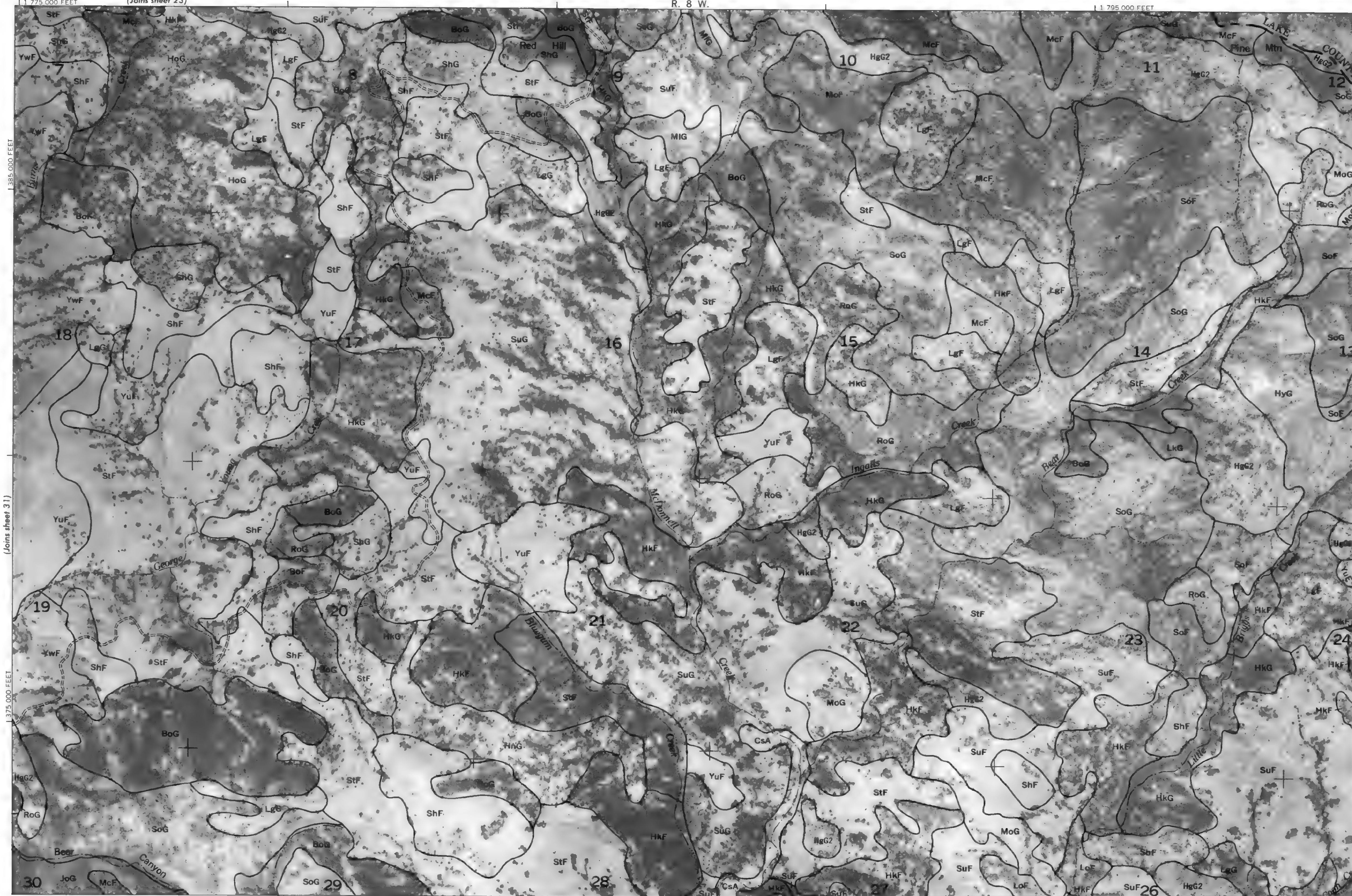
Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 32

N

Scale 1:20 000

1 Mile | 5000 Feet | 0 | 1000 | 2000 | 3000 | 4000 | 5000 | 0 | ¼ | ½ | ¾ | 1



Land division corners are approximately positioned on this map.

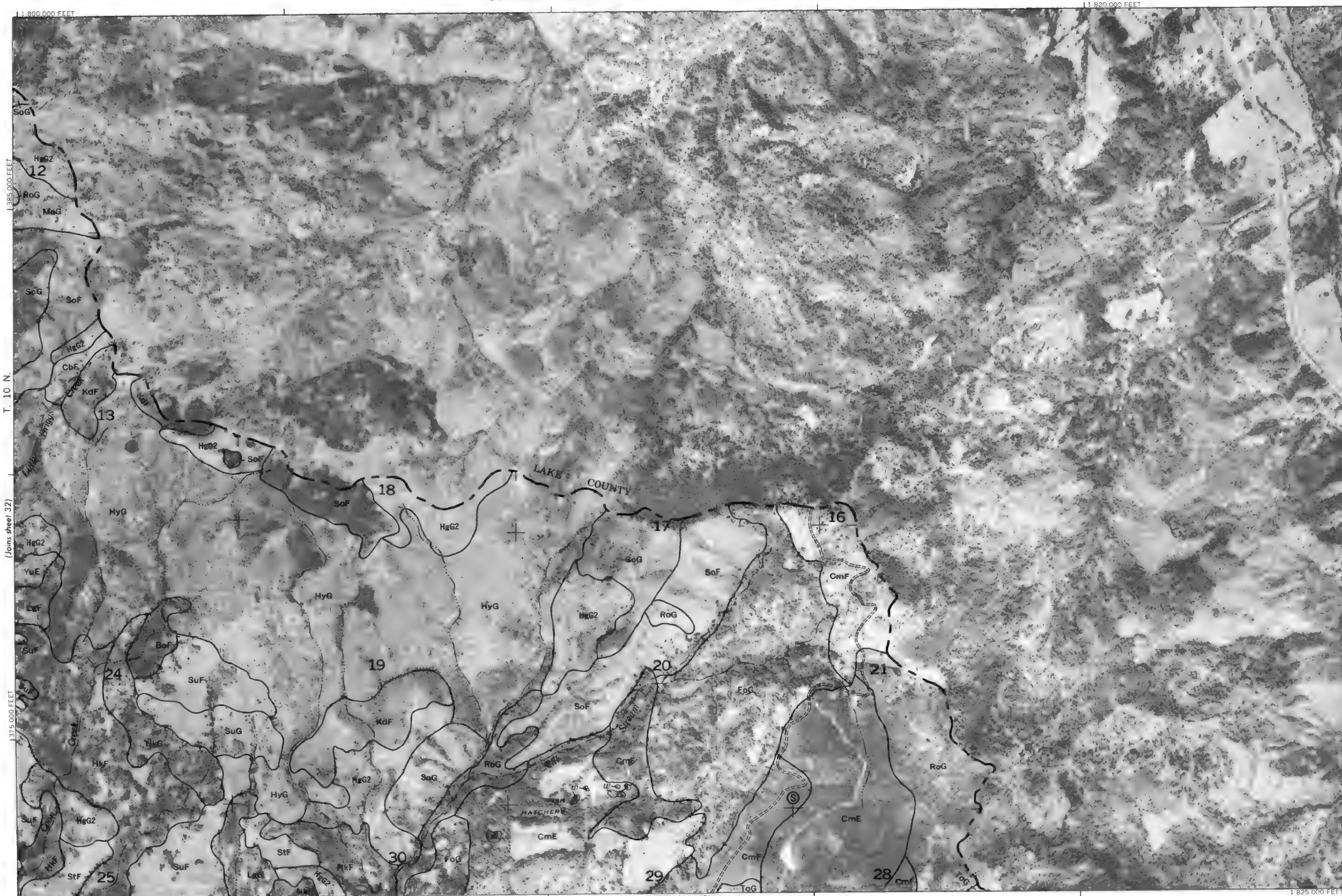
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SOMOMA COUNTY, CALIFORNIA NO. 32

33

N



(Joins sheet 32)

(Joins sheet 42)

R. 8 W. | R. 7 W.

T. 10 N.

SONOMA COUNTY, CALIFORNIA NO. 33

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

1 Mile

5000 Feet

0

1000

2000

3000

4000

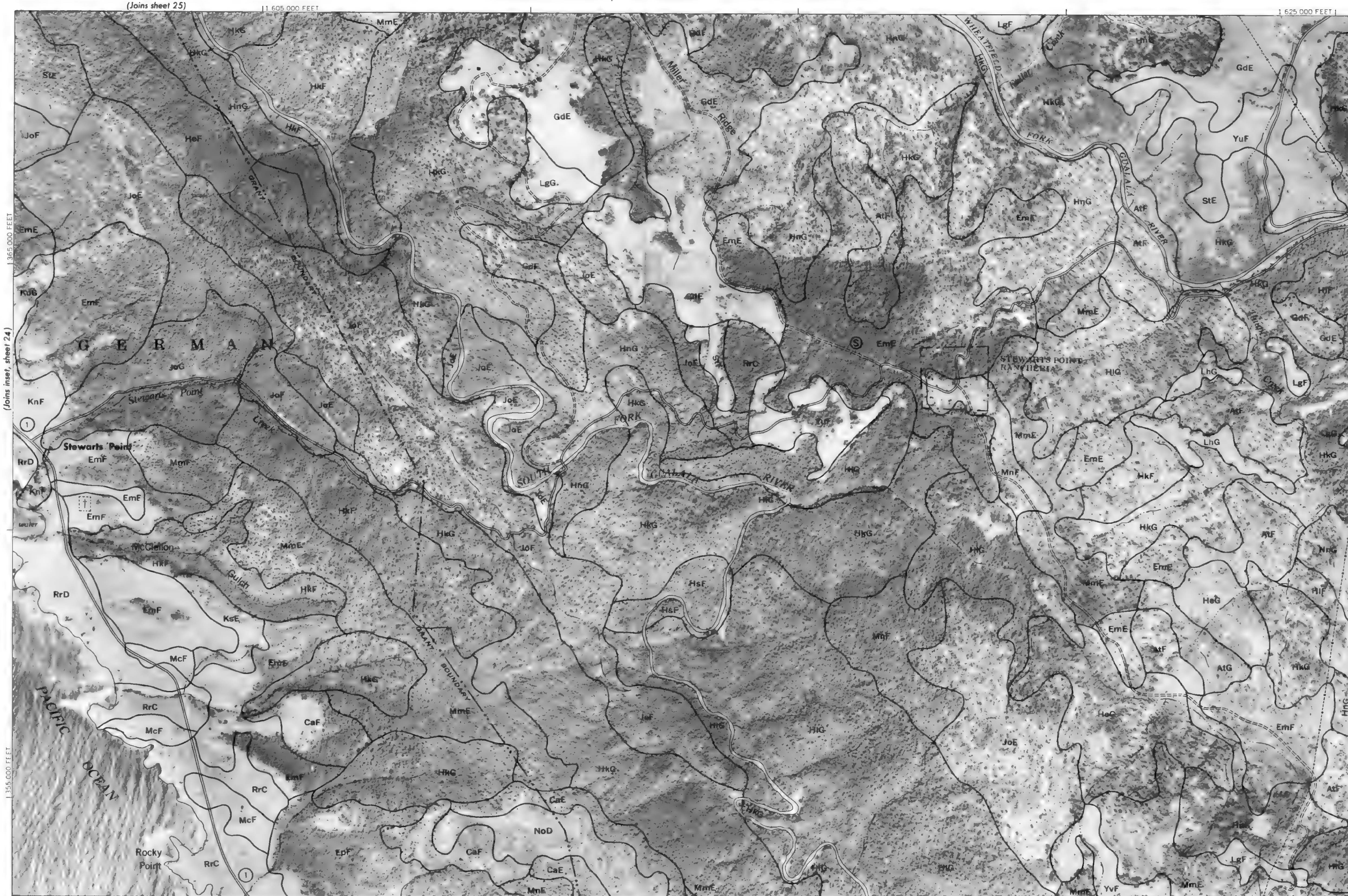
5000

0 ¼ ½ ¾ 1

Scale 1:20 000

N

(Joins sheet 25)



(Joins sheet 43)

1 Mile

5000 Feet

Scale 1:20 000

0 1000 2000 3000 4000 5000

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

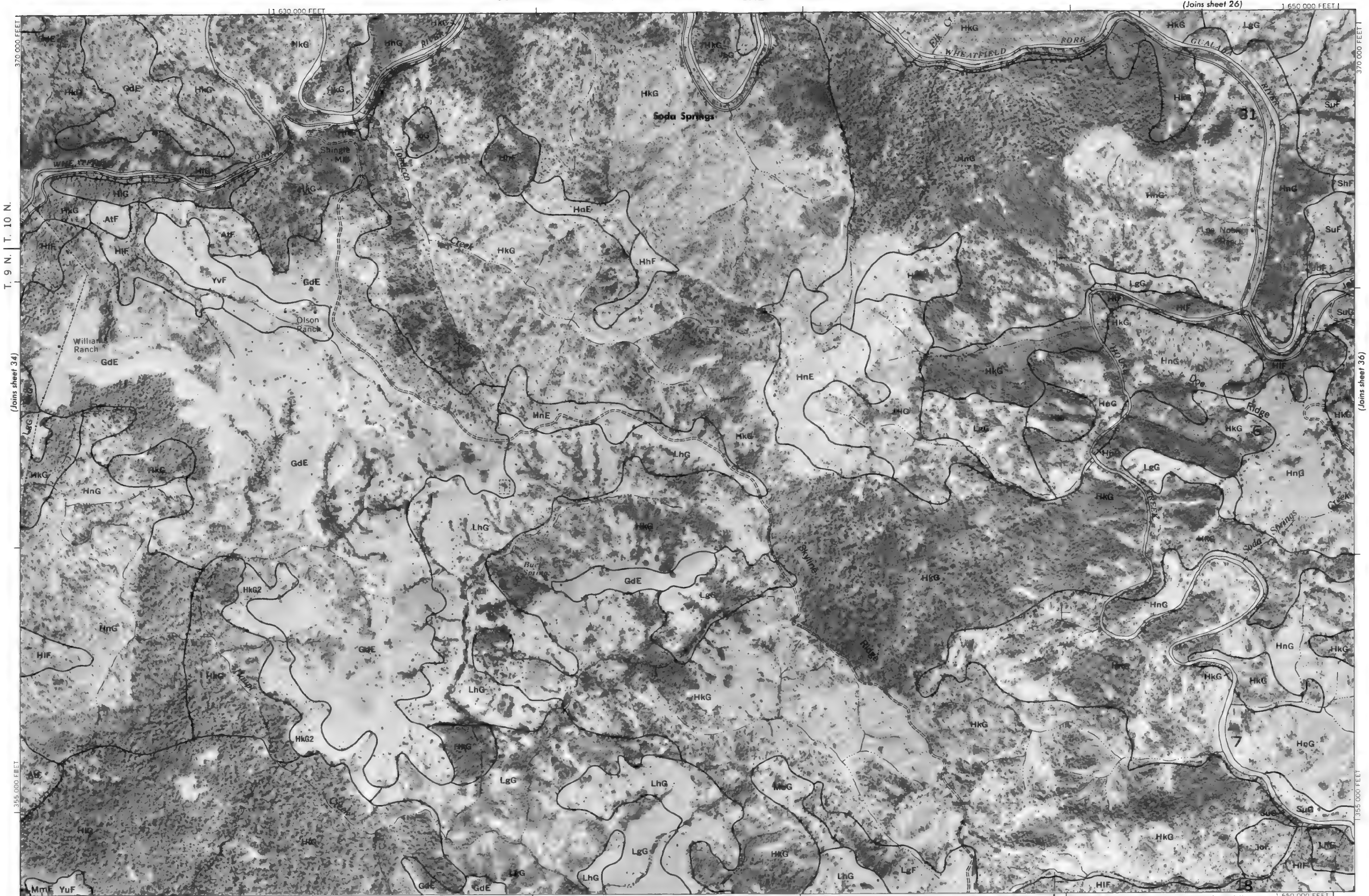
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 35

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.



N

Scale 1:20 000

1 Mile

5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 36

N

Scale 1:20 000

1 Mile

5000 Feet

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

37

N

Scale 1:20 000

1 Mile

5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

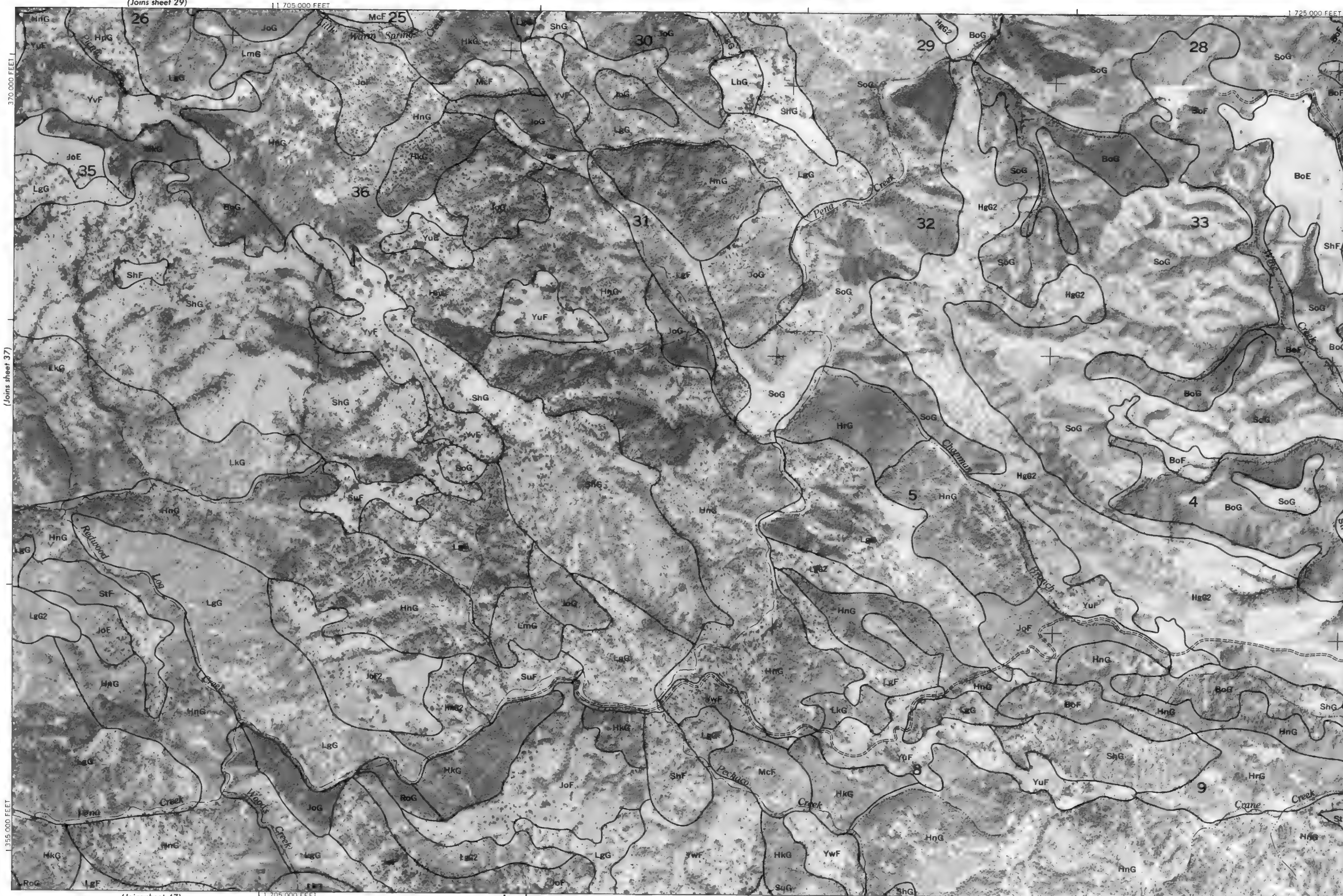
SONOMA COUNTY, CALIFORNIA NO. 37

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 38



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 39

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum
Land division corners are approximately positioned on this map.

(40)

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 40

N

1 Mile
5000 Feet
Scale 1:20 000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

Land division corners are approximately positioned on this map.

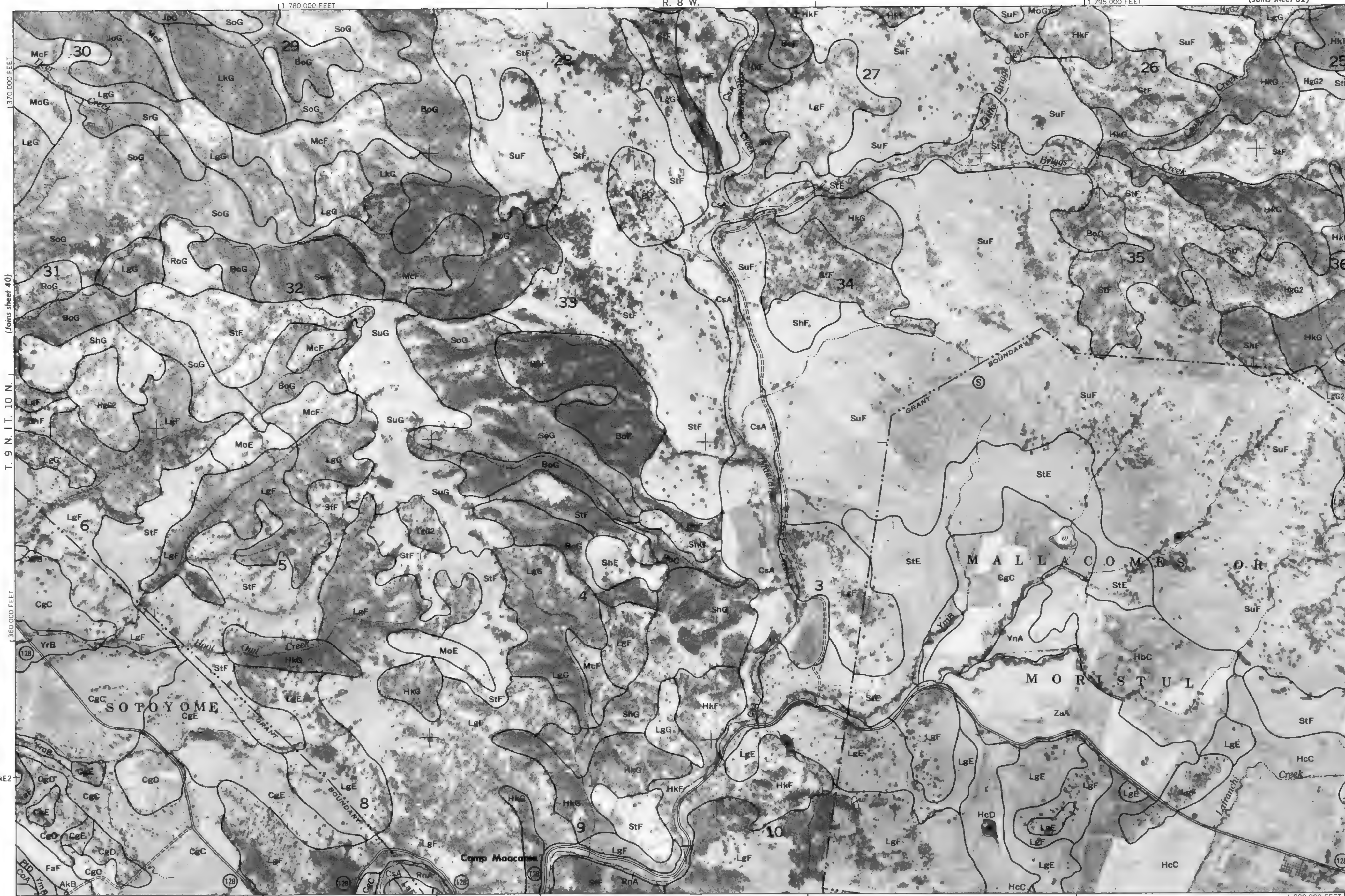
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 40

SONOMA COUNTY, CALIFORNIA NO. 41

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum
Land division corners are approximately positioned on this map.

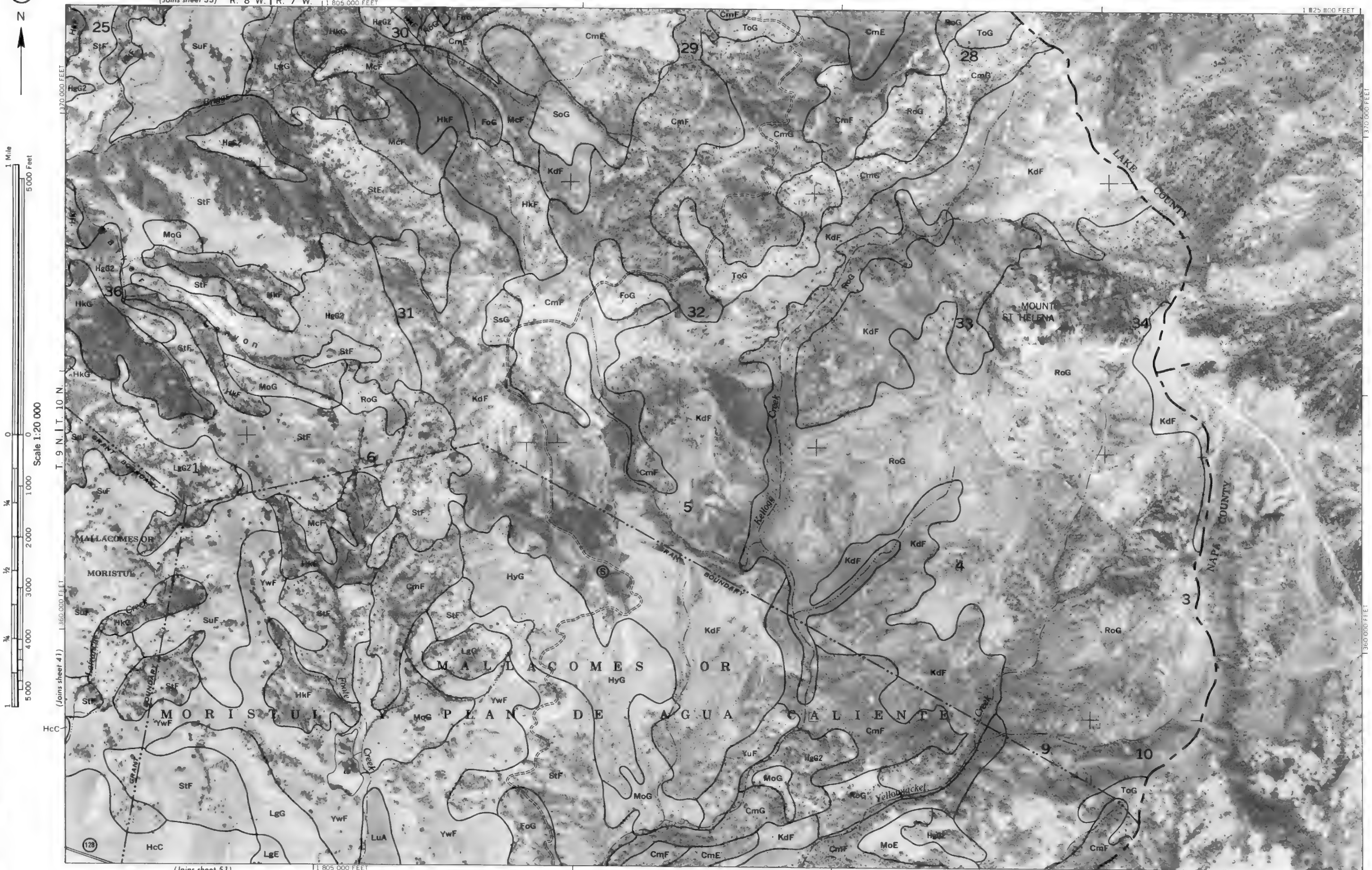


N

1 Mile
5000 Feet
0
1/4
1/2
3/4
1000
2000
3000
4000
5000
Scale 1:20 000

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 42

(Joins sheet 33) R. 8 W. | R. 7 W.

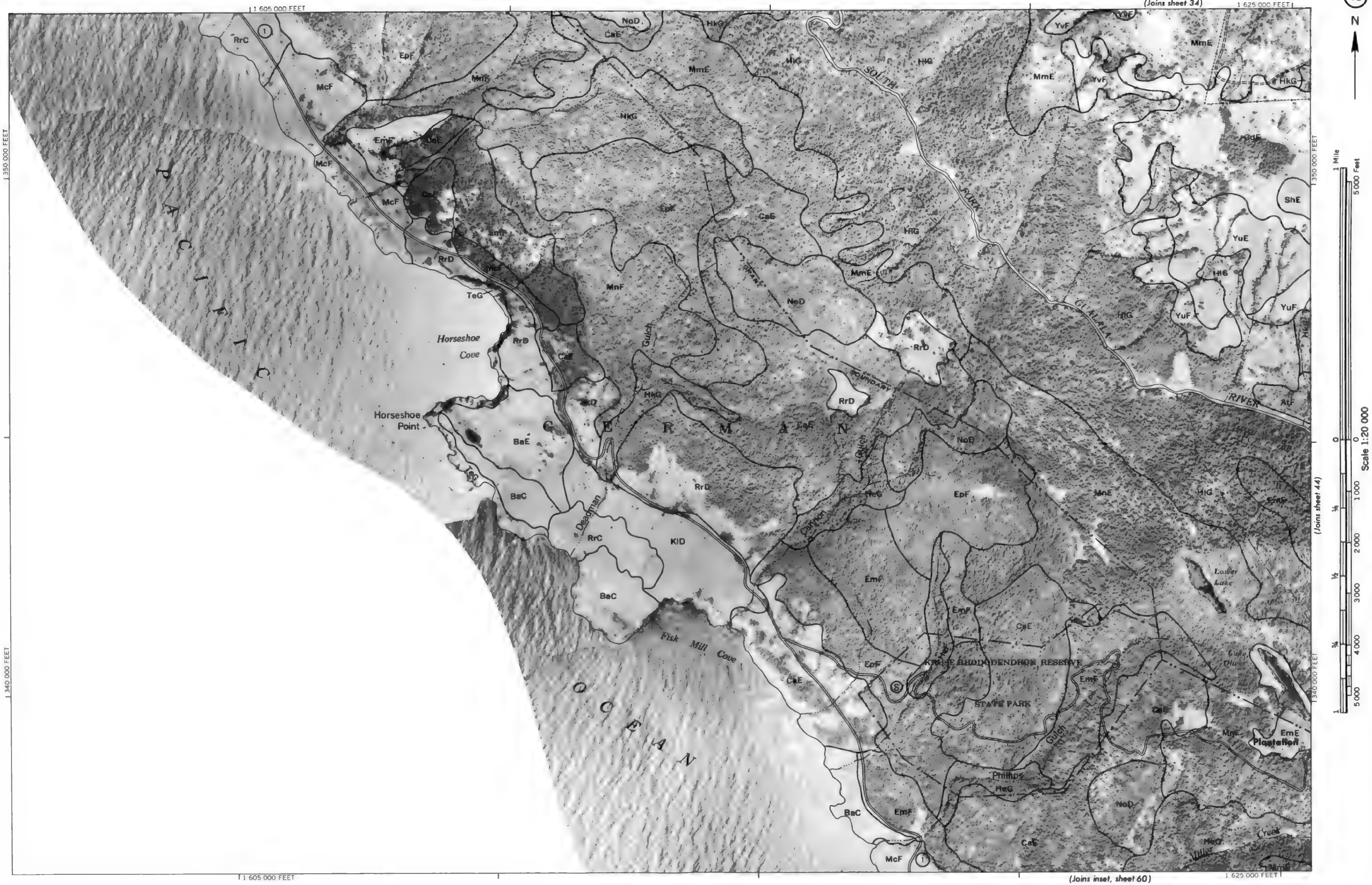


Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 42



SONOMA COUNTY, CALIFORNIA NO. 43

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

(44)

N

(Joins sheet 35)

(Joins sheet 43)

(Joins sheet 45)

(Joins sheet 52)

1 Mile
5000 Feet
Scale 1:20 000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

T. 9 N.

R. 13 W. | R. 12 W.

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 44

SONOMA COUNTY, CALIFORNIA NO. 45

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 46

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 46

SONOMA COUNTY, CALIFORNIA NO. 47

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum.
Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 48

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 48

SONOMA COUNTY, CALIFORNIA NO. 49
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 50

N

(Joins sheet 41)

R. 8 W.

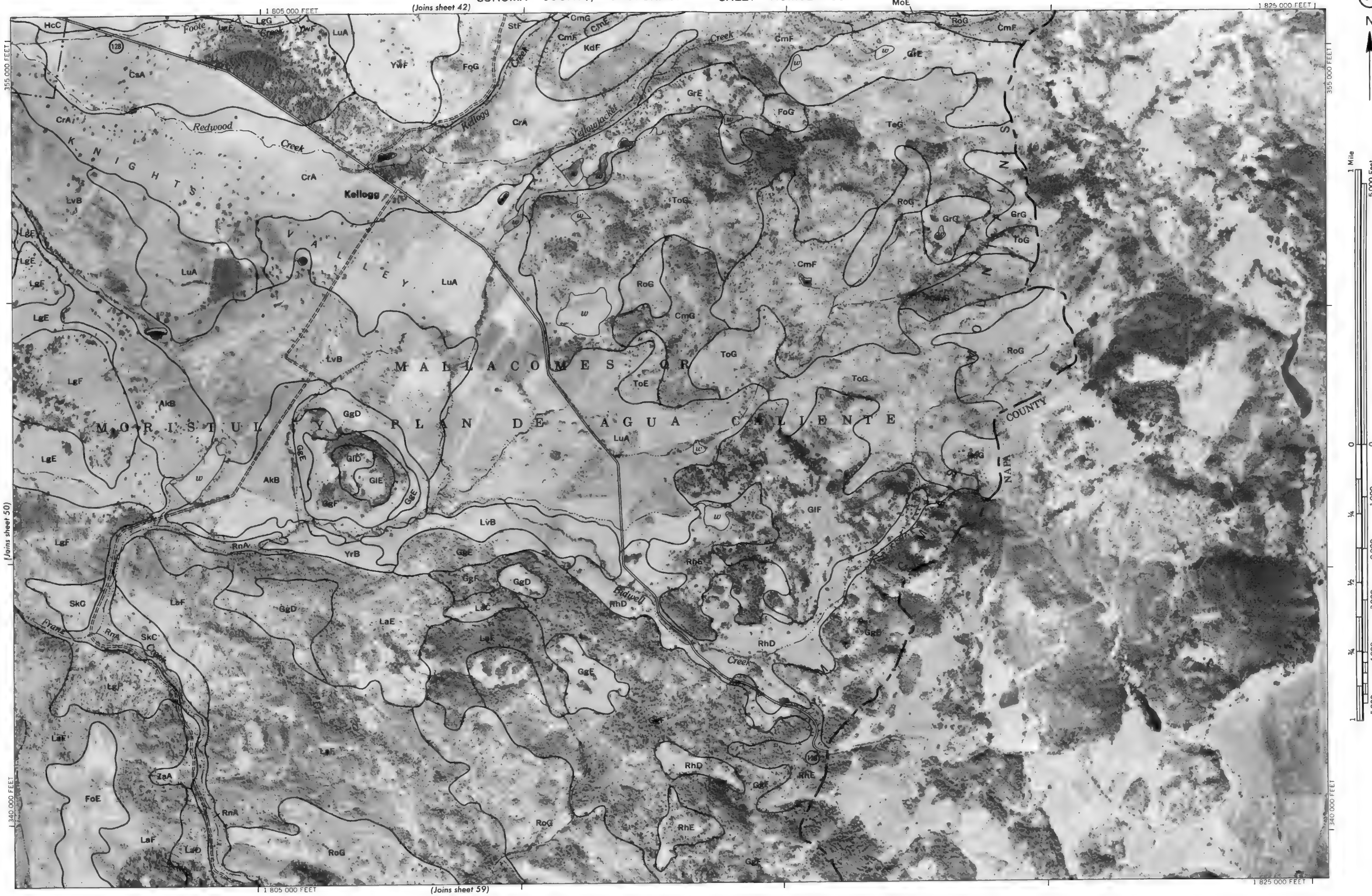
(Joins sheet 58)

1 Mile
5000 Feet
Scale 1:20 000

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

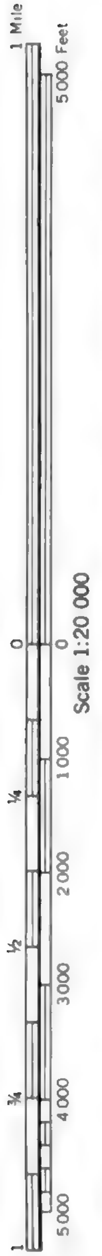
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station



SONOMA COUNTY, CALIFORNIA NO. 51

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 52



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 53

53

SONOMA COUNTY, CALIFORNIA NO. 53

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 54

N

Scale 1:20 000

1 Mile

5000 Feet

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 55

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2 1927 North American Datum

Land division corners are approximately positioned on this map.

56

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 56

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 56

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 57

SONOMA COUNTY, CALIFORNIA NO. 57

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

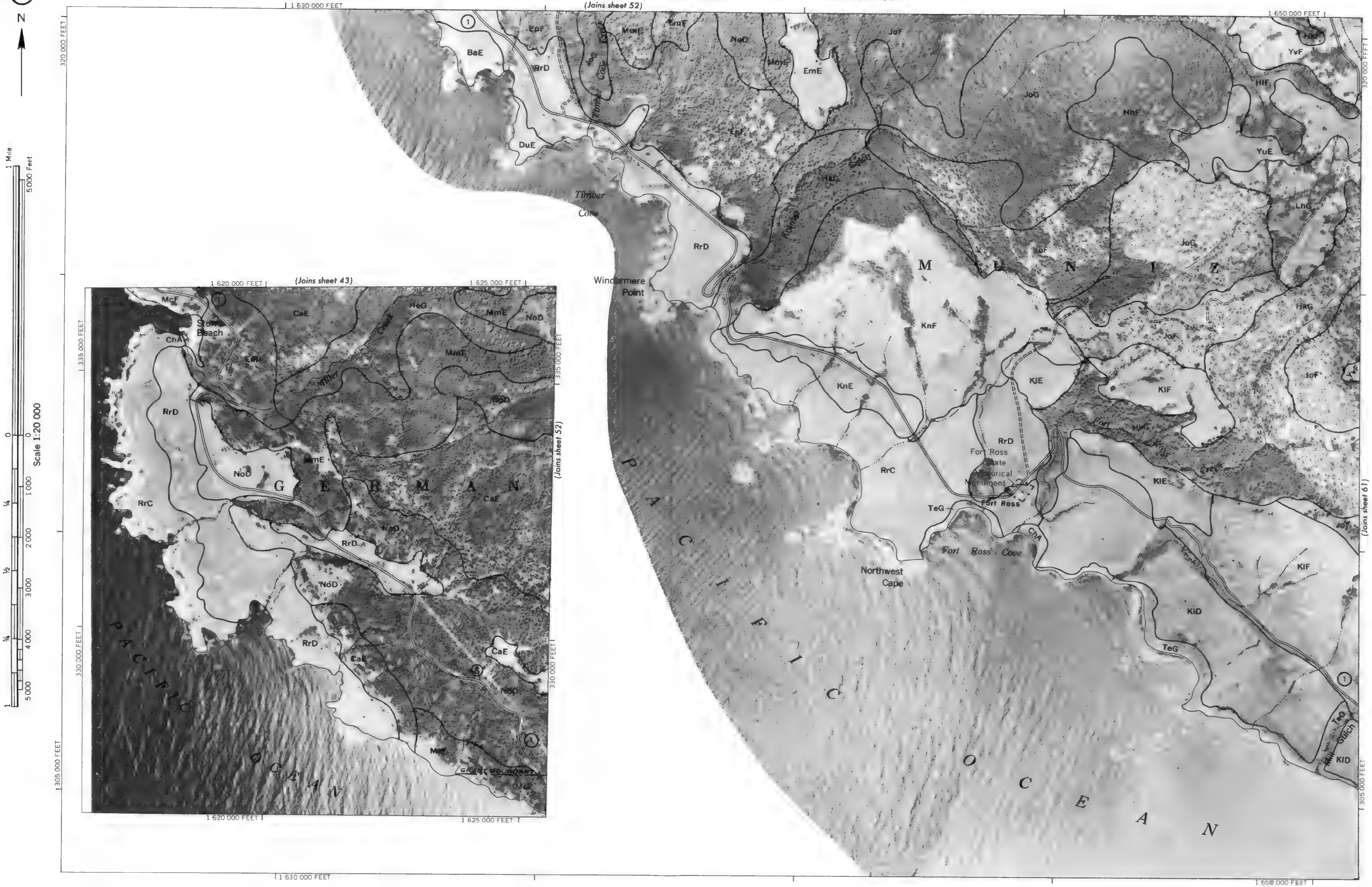
SONOMA COUNTY, CALIFORNIA NO. 59

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 60



Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

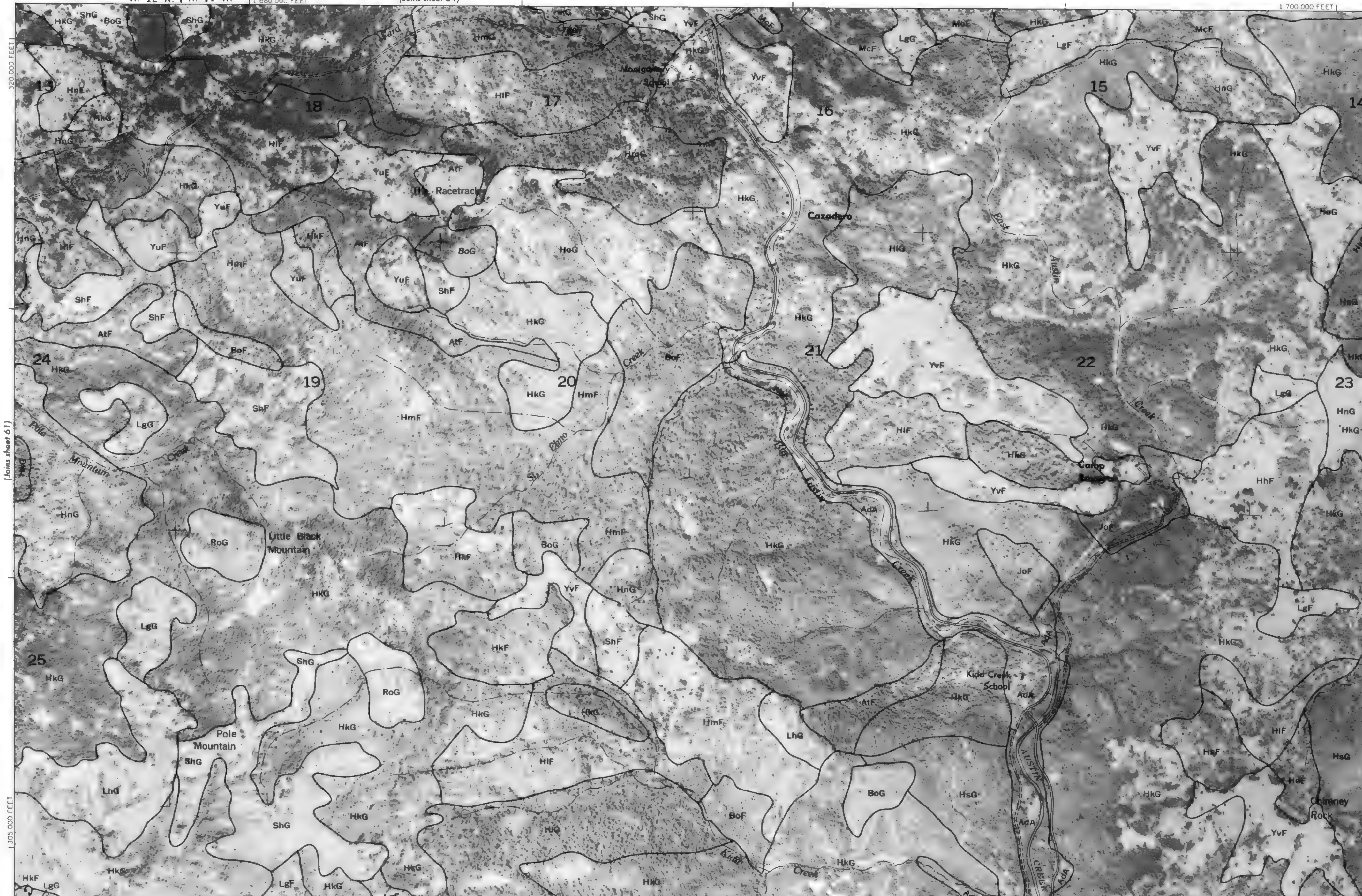
SONOMA COUNTY, CALIFORNIA NO. 61

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 62



N

Scale 1:20 000

1 Mile

5000 Feet

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

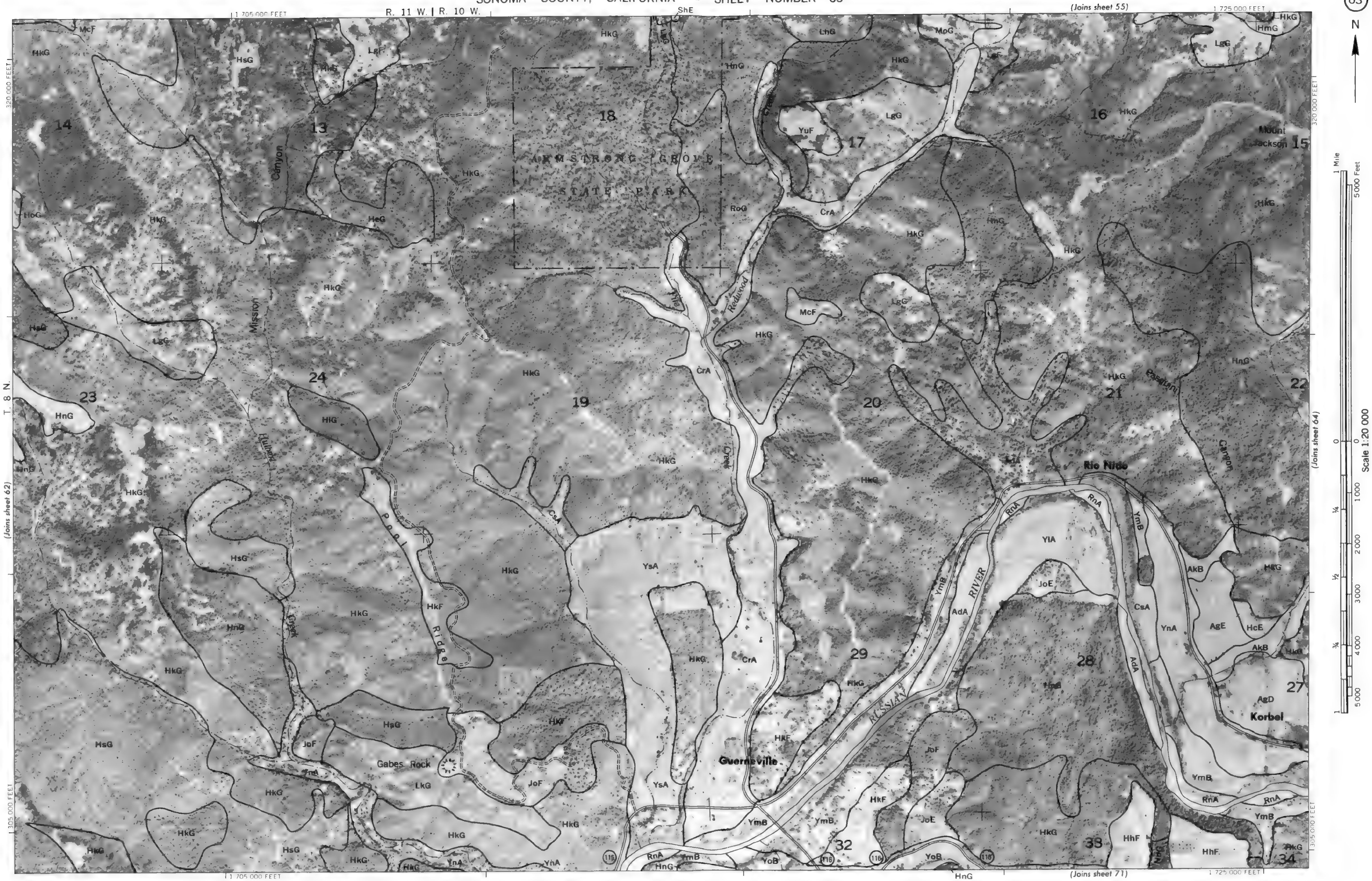
Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 62

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 63



SONOMA COUNTY, CALIFORNIA NO. 63

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum.
Land division corners are approximately positioned on this map

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 65

SONOMA COUNTY, CALIFORNIA NO. 65

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

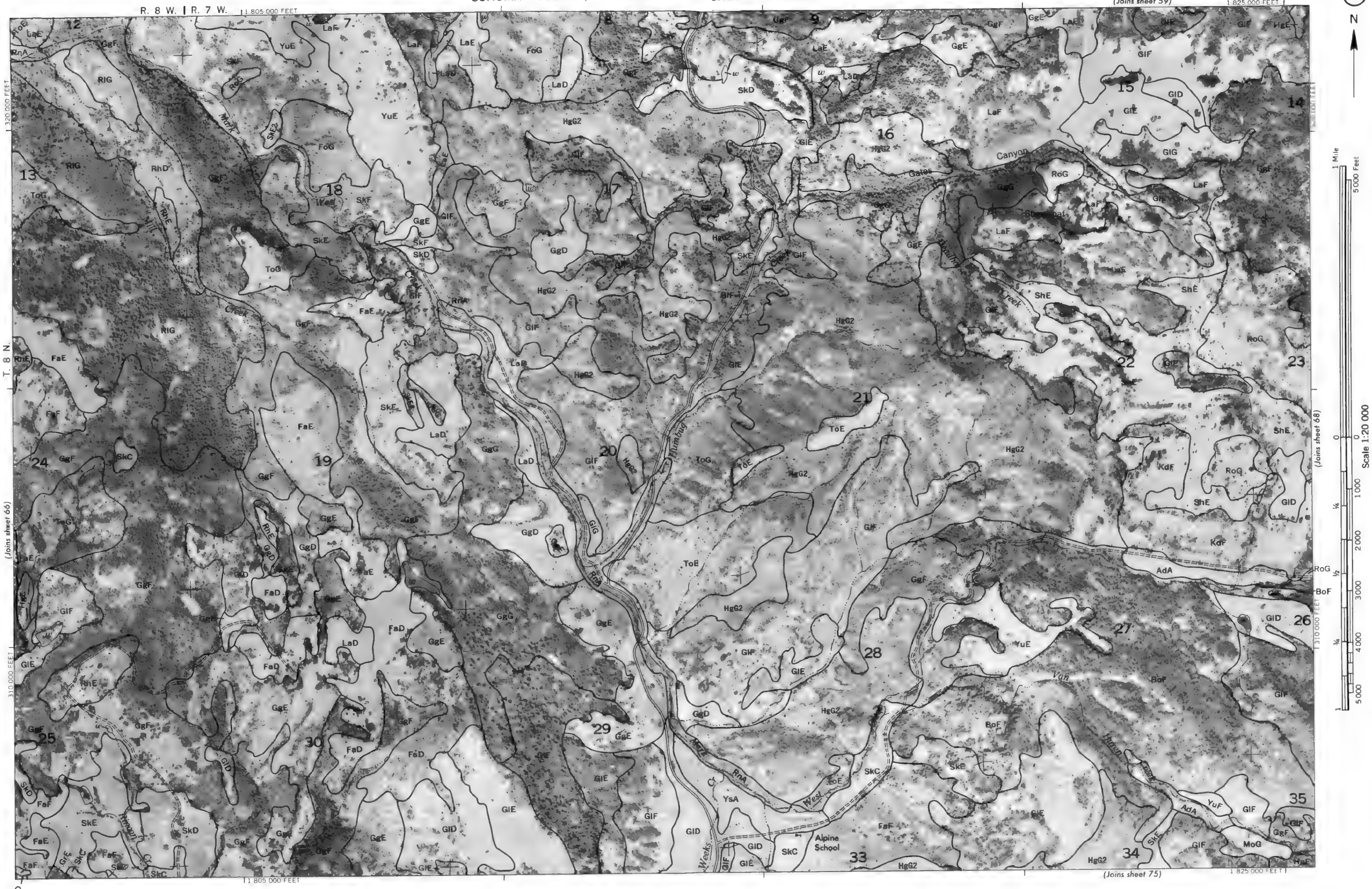
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2 1927 North American Datum

Land division corners are approximately positioned on this map.

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

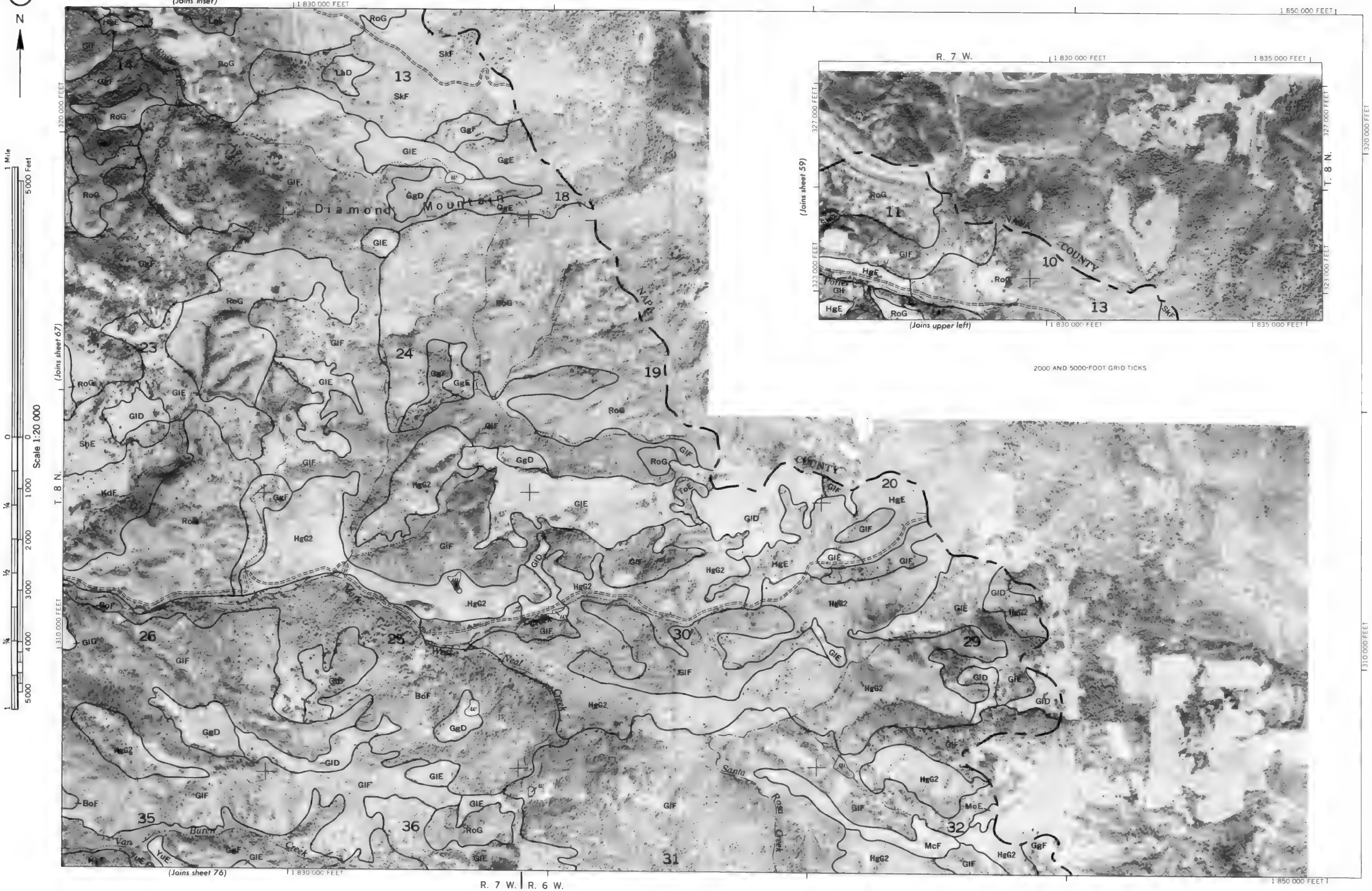


SONOMA COUNTY, CALIFORNIA NO. 67

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.



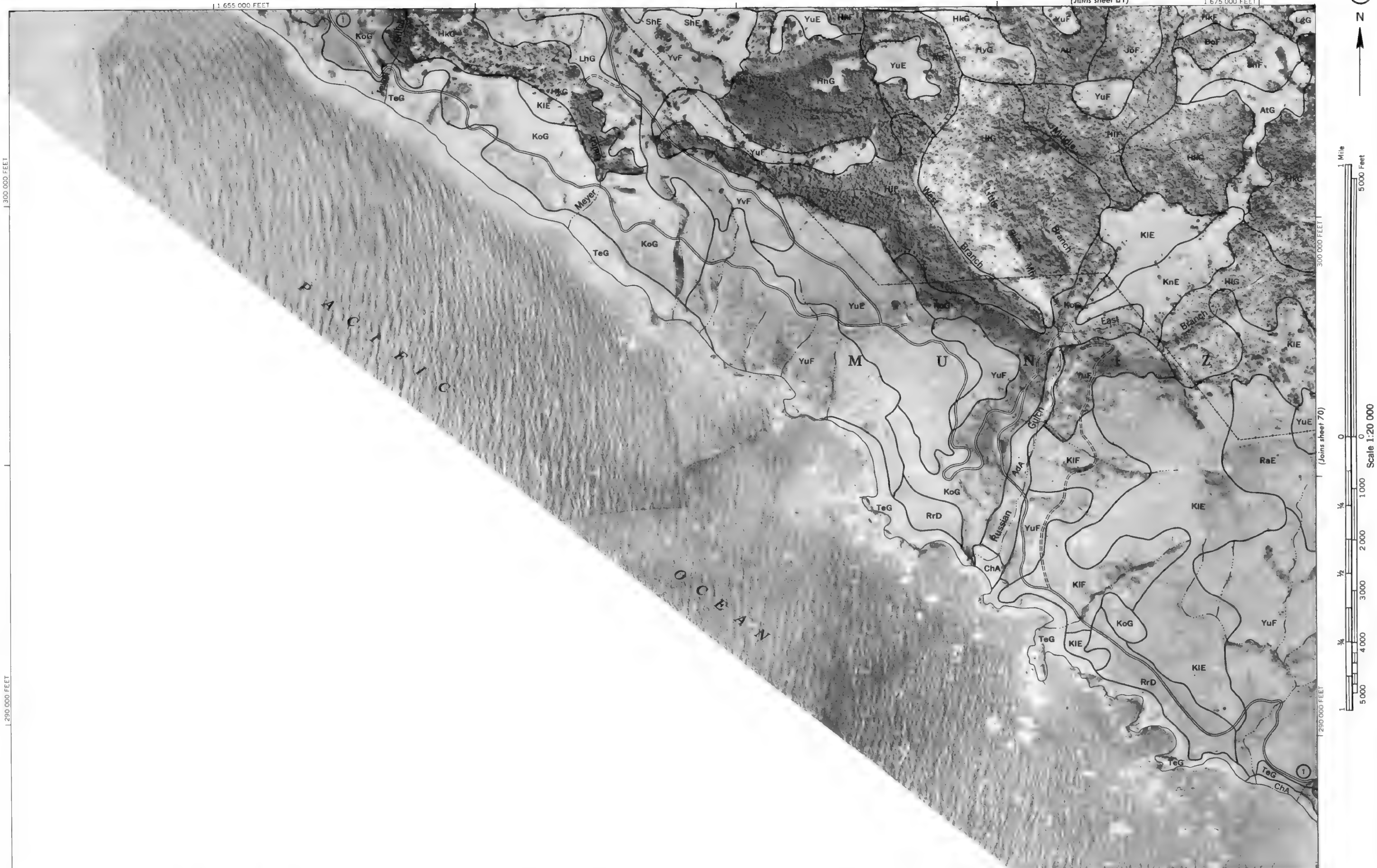
Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 68

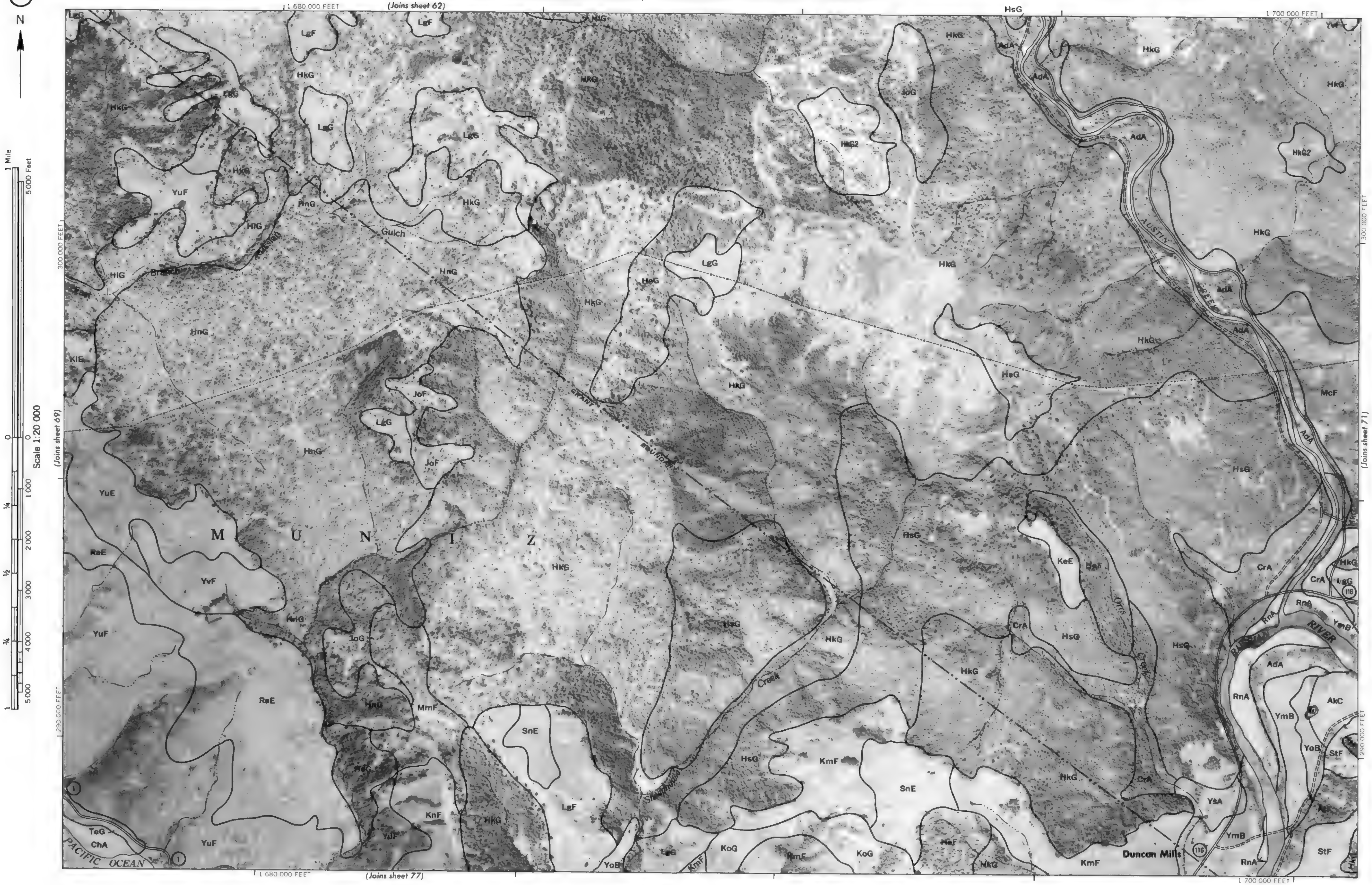
69



SONOMA COUNTY, CALIFORNIA NO. 69

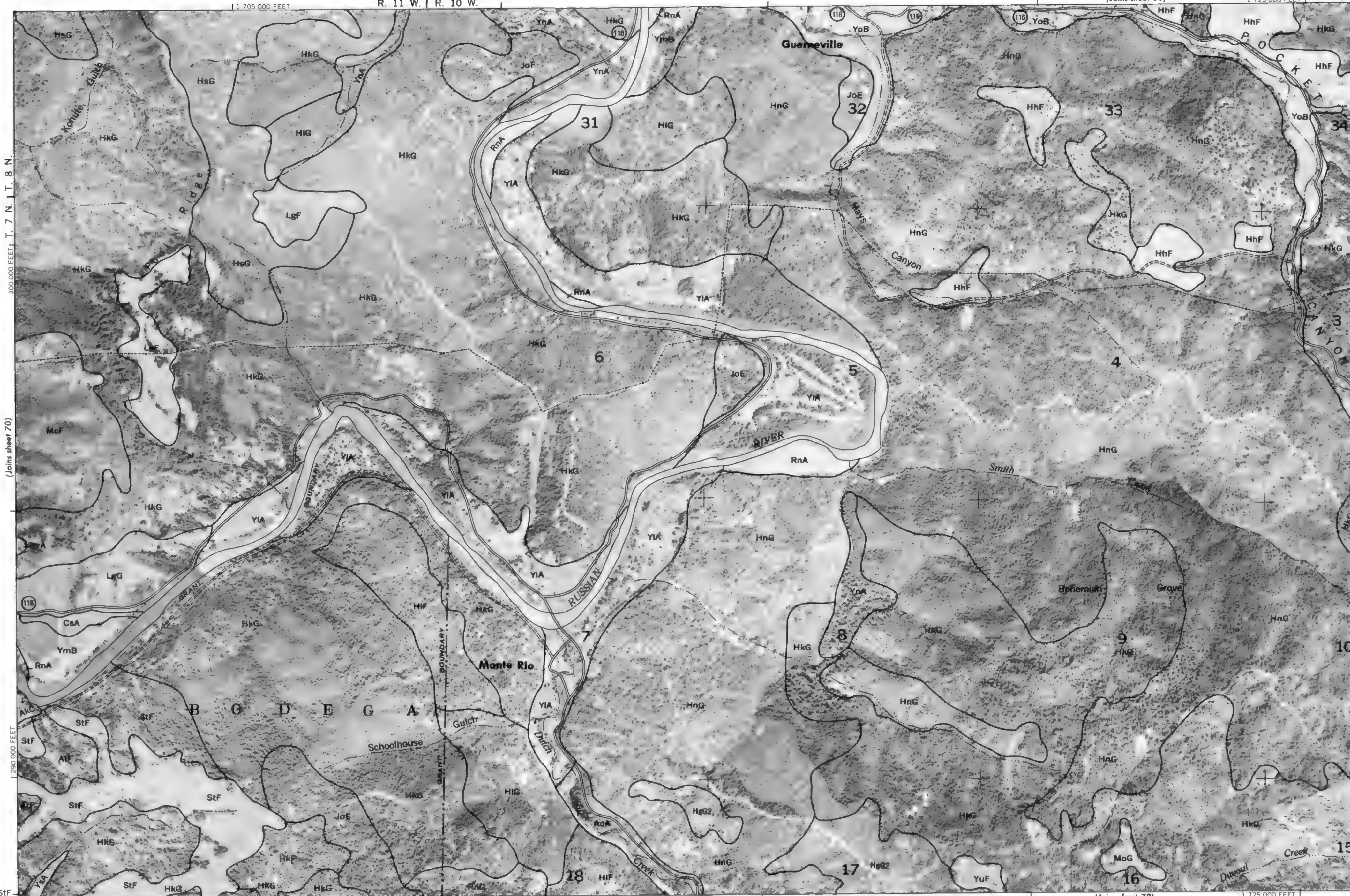
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 70



Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station



Scale 1:20 000

1 Mile

5000 Feet

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000

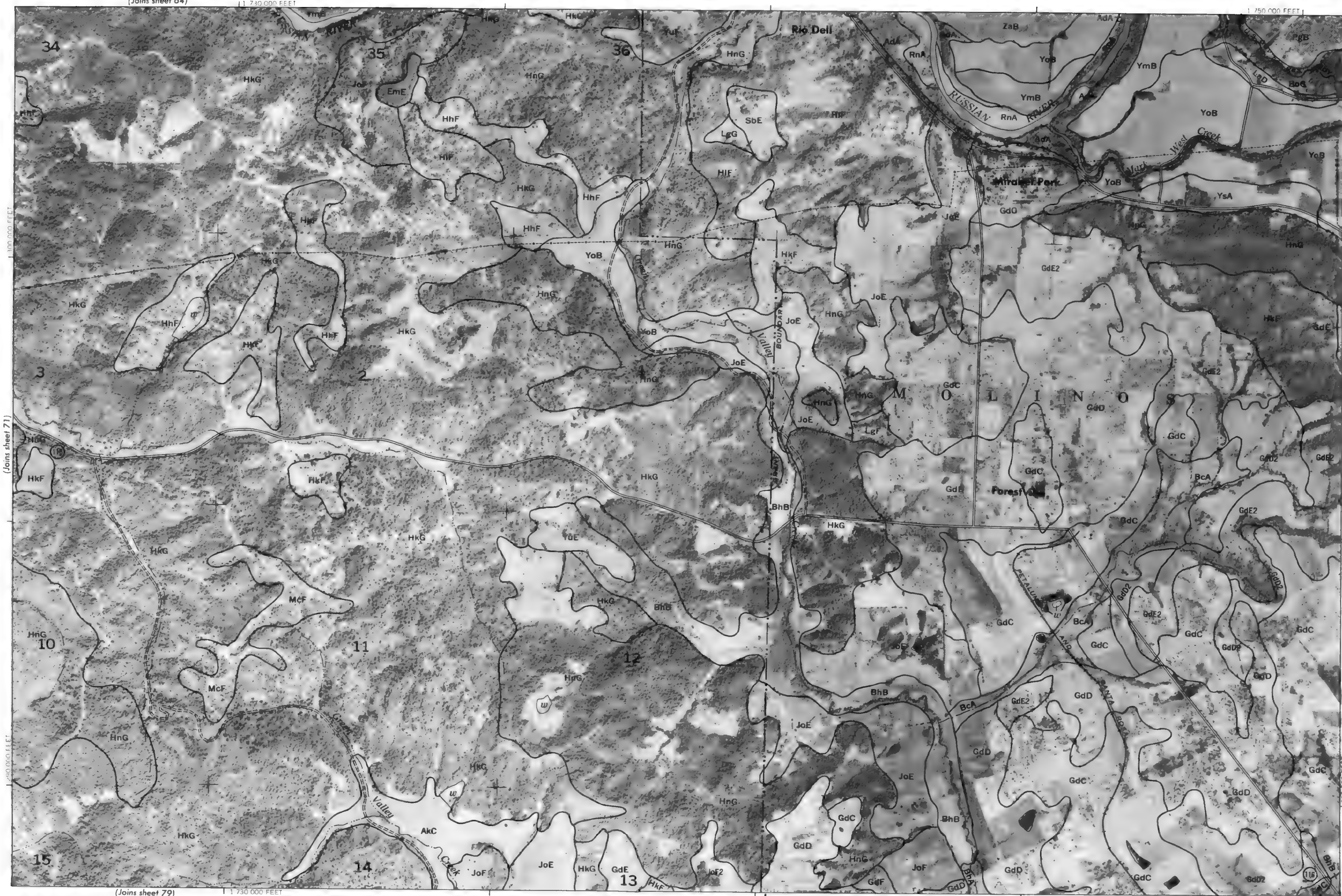
SONOMA COUNTY, CALIFORNIA NO. 71

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 72



Scale 1:20 000

1 Mile

5000 Feet

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 73

SONOMA COUNTY, CALIFORNIA NO. 73

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 74

N

(Joins sheet 66)

1 780 000 FEET

R. 8 W.

1 800 000 FEET

305 000 FEET

1 Mile
5000 Feet
Scale 1:20 000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

(Joins sheet 73)

(Joins sheet 75)

T. 8 N.
T. 7 N.

290 000 FEET

(Joins sheet 81)

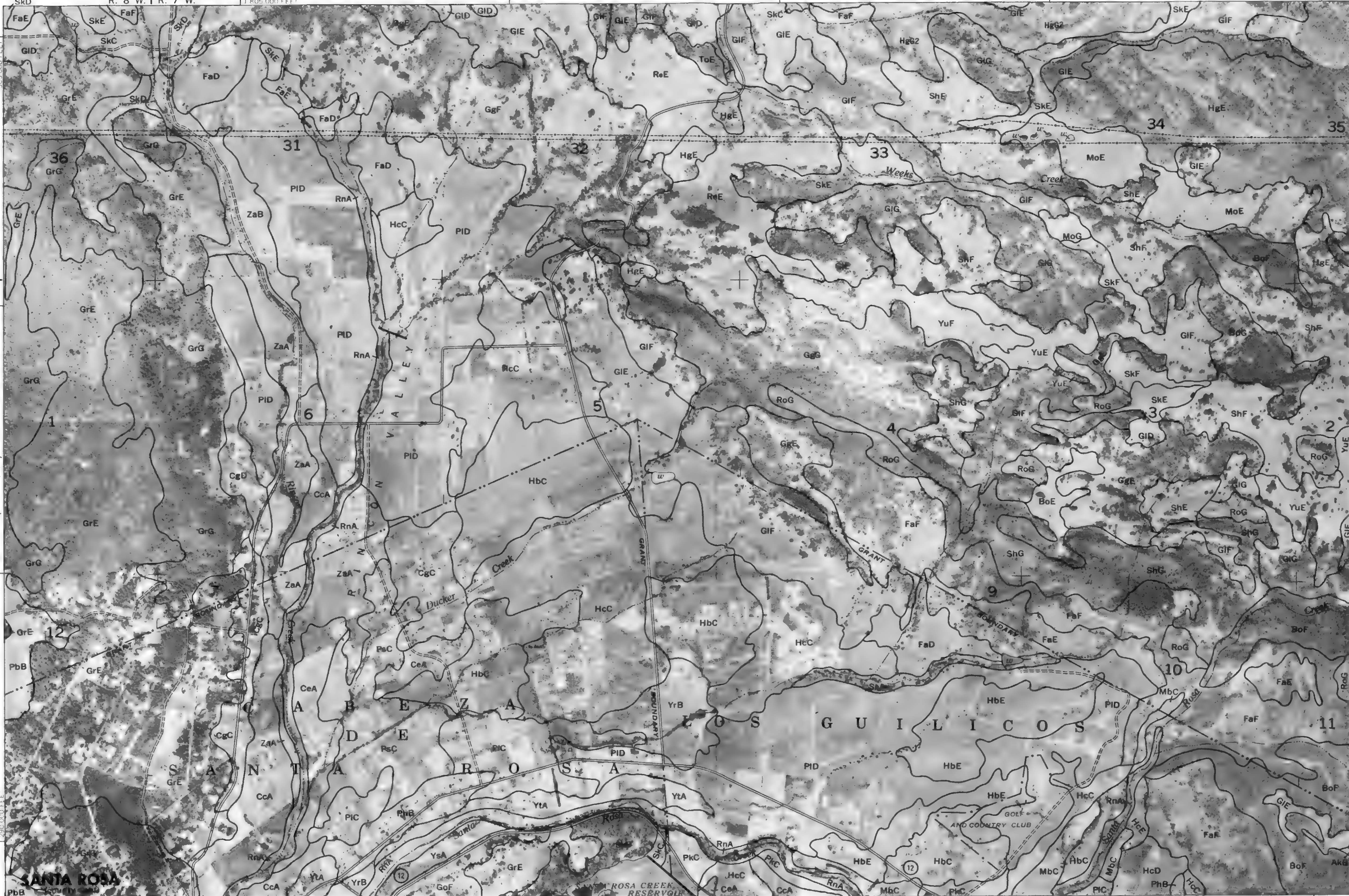
1 780 000 FEET

1 800 000 FEET

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station



SONOMA COUNTY, CALIFORNIA NO. 75

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.
Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 76

N

Scale 1:20 000

1 Mile | 5000 Feet | 0 | 1000 | 2000 | 3000 | 4000 | 5000

R. 7 W. | R. 6 W.

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

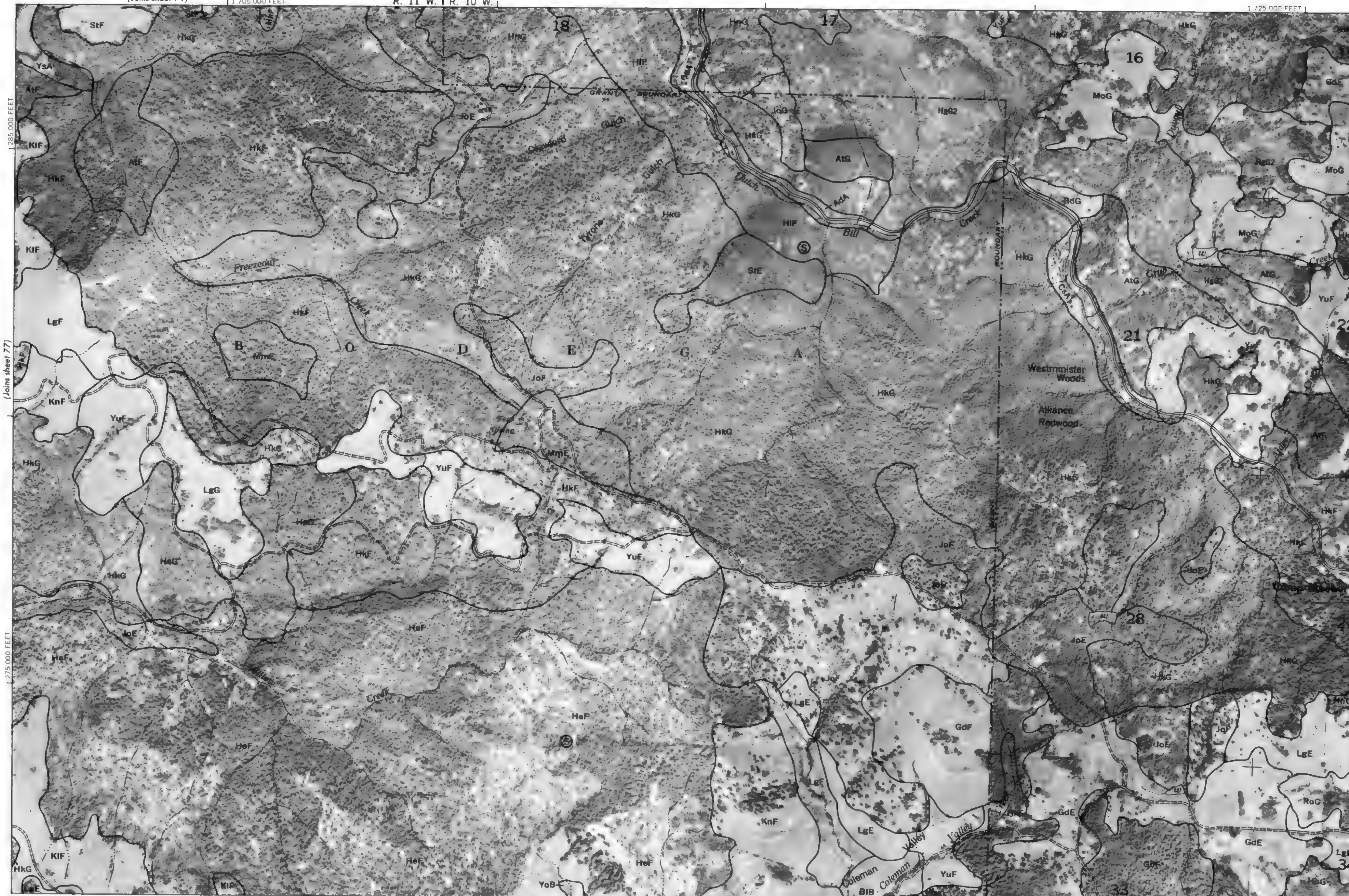
SONOMA COUNTY, CALIFORNIA NO. 76

SONOMA COUNTY, CALIFORNIA NO. 77

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 78



Scale 1:20 000
1 Mile
5000 Feet
0 1000 2000 3000 4000 5000
¼ ½ ¾ 1

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

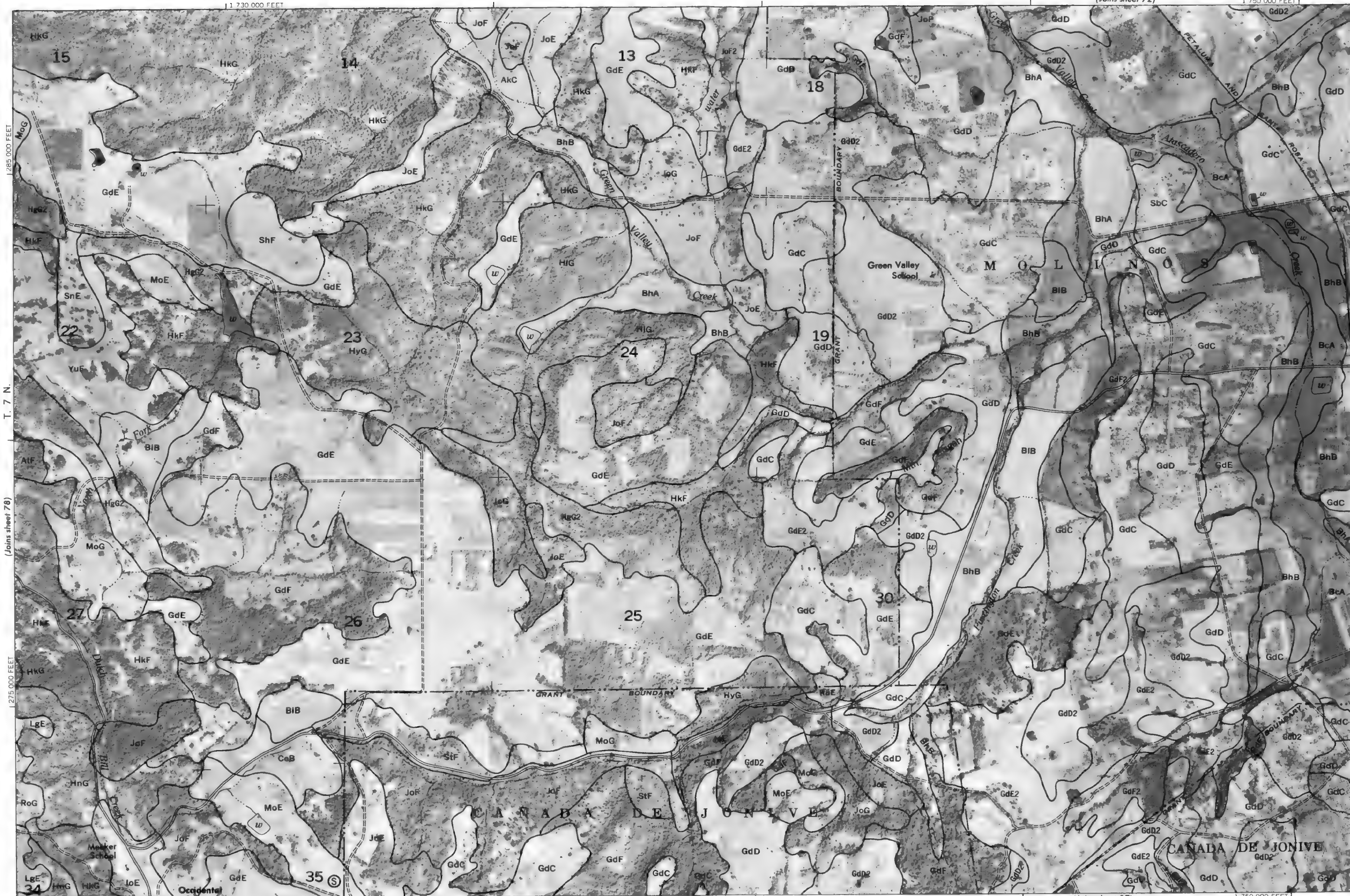
This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 78

SONOMA COUNTY, CALIFORNIA NO. 79

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.



SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 80

N

Scale 1:20 000

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 81

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum.
Land division corners are approximately positioned on this map.

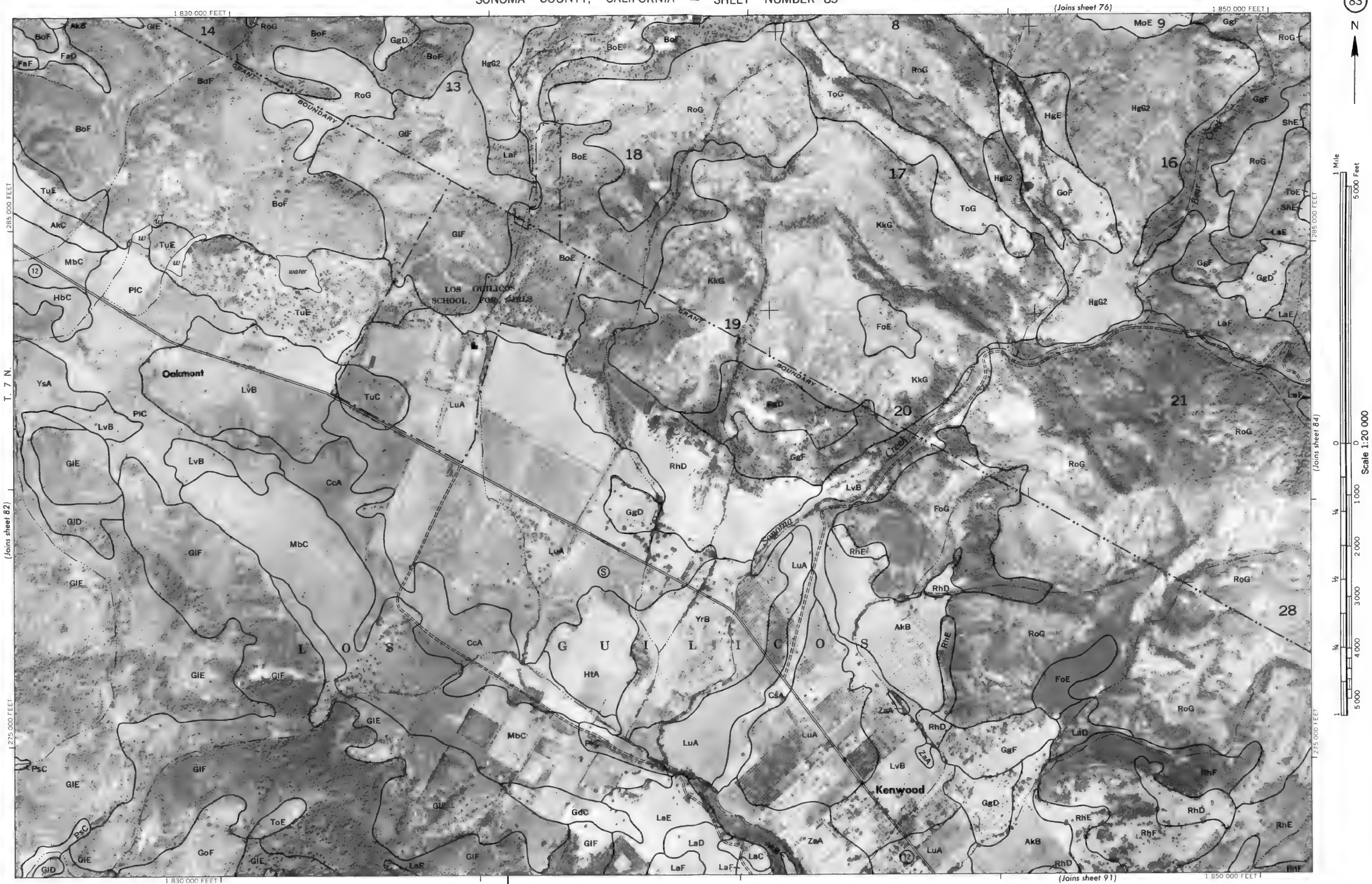
SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 82

Land division corners are approximately positioned on this map.

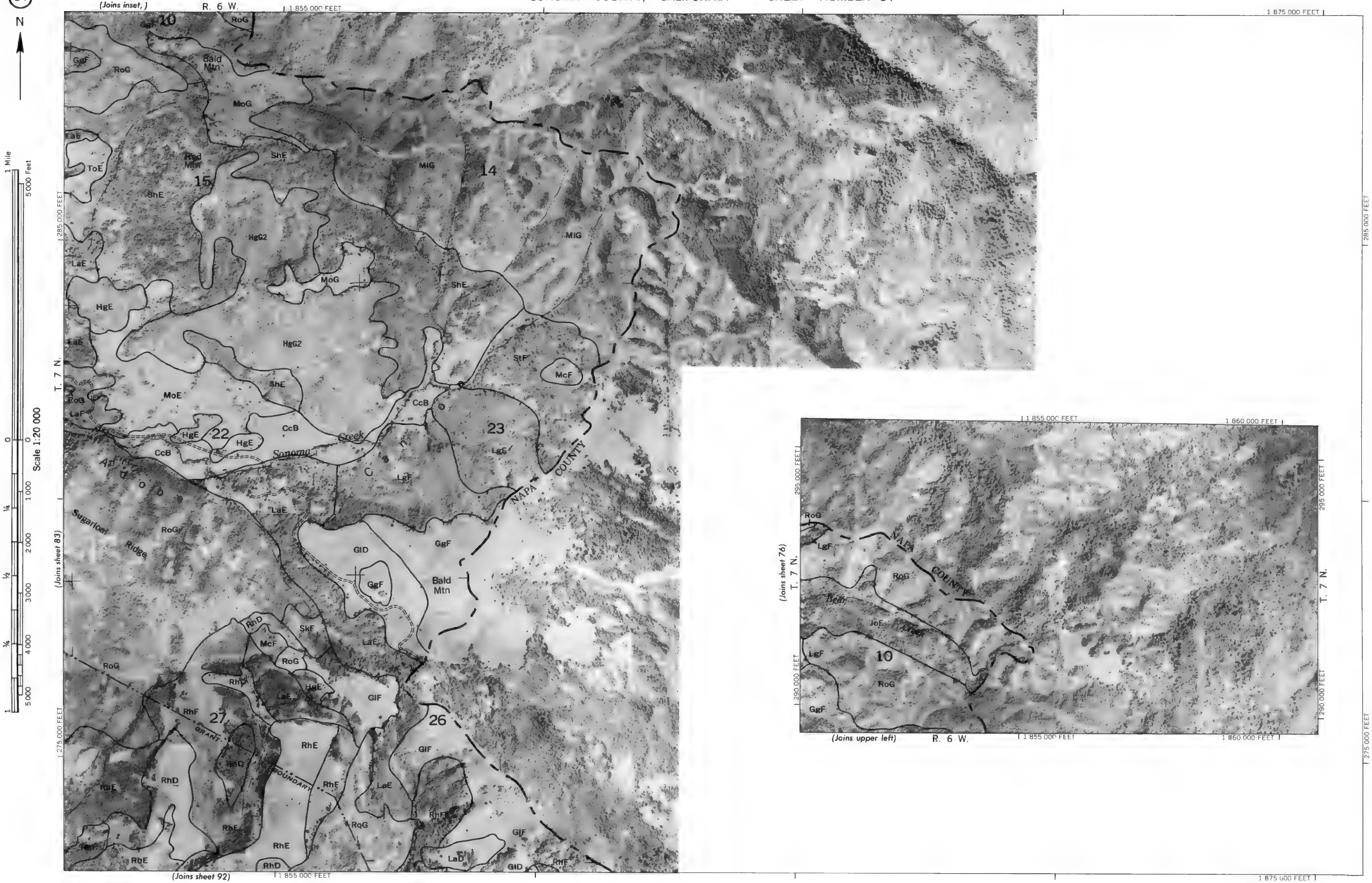
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 82


(Joins sheet 76)
(Joins sheet 82)
(Joins sheet 84)
(Joins sheet 91)
1 830 000 FEET
1 850 000 FEET
285 000 FEET
275 000 FEET
T. 7 N.
R. 7 W.
R. 6 W.
N
Scale 1:20 000
1 Mile
5 000 Feet
GRANT BOUNDARY
LOS GUILICOS SCHOOL FOR GIRLS
L O S G U I L I C O S
Oakmont
Kenwood
Sonoma Creek
Bear Creek
water
12
13
14
16
17
18
19
20
21
28
BoF
RoG
GlF
GlE
KkG
HgG2
ToG
MbC
LvB
LuA
CcA
RhD
RhE
RhF
AkB
GgD
GgF
FoE
FoG
HtA
YrB
TuE
TuC
PlC
YsA
HbC
AkC
LaF
LaE
LaD
LaC
ZaA
GdC
GoF
PsC
ToE
BoE
ShE
MoE

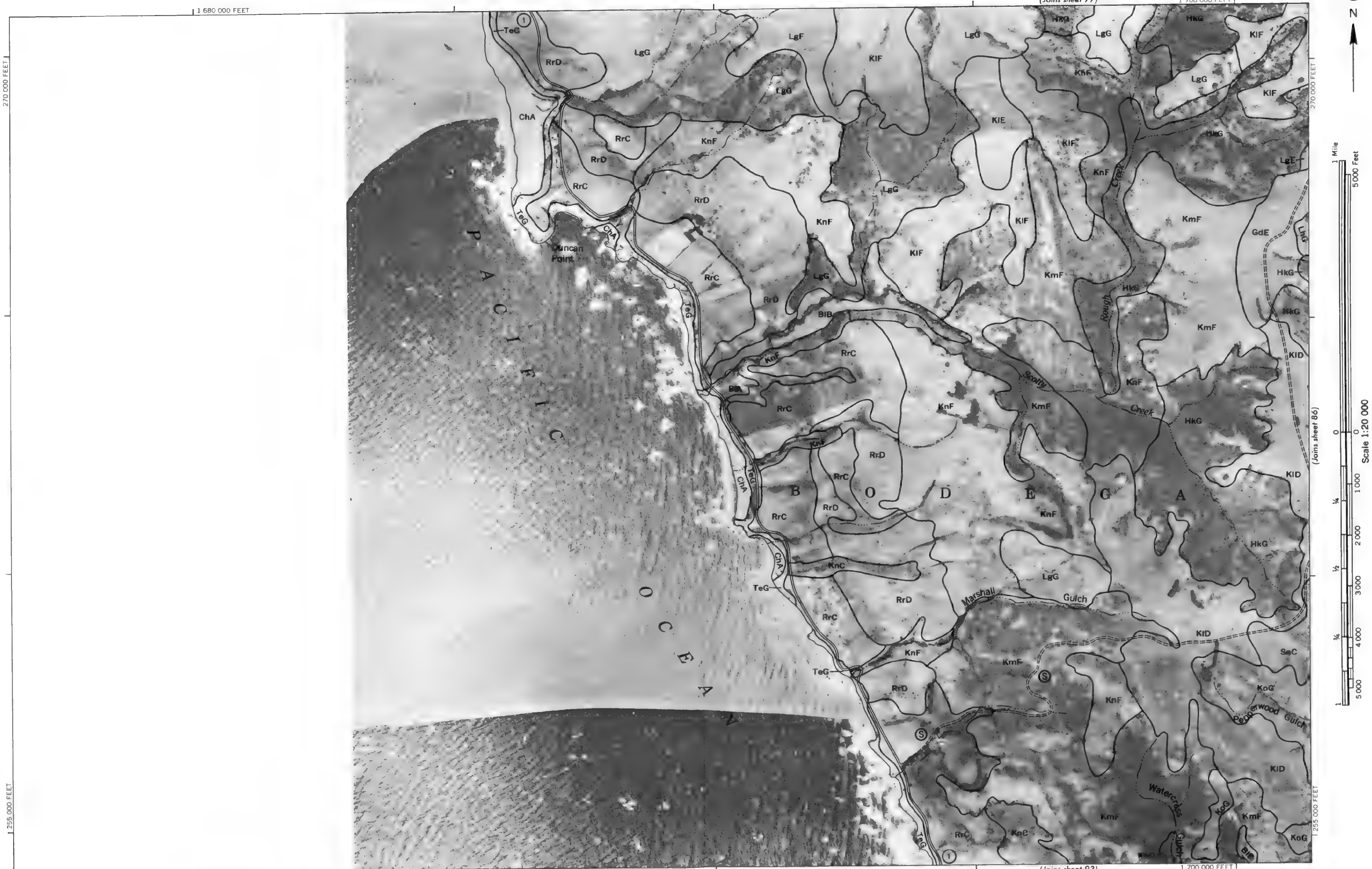
SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 84



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.



SONOMA COUNTY, CALIFORNIA NO. 85

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 86

Land division corners are approximately positioned on this map

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA NO. 87

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

R. 10 W. | R. 9 W.

N

1 Mile

5000 Feet

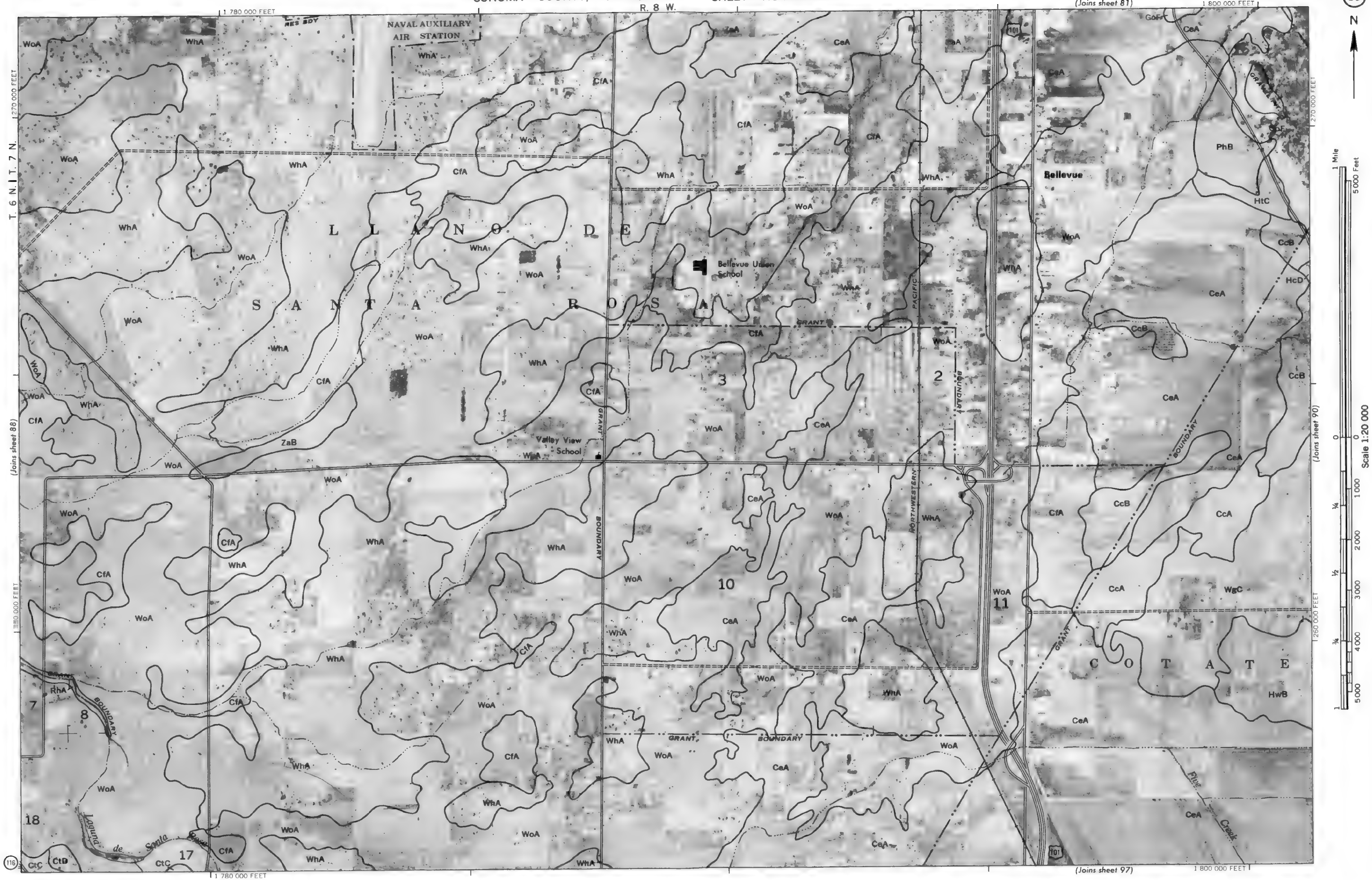
Scale 1:20 000

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 89



This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 90

N

Scale 1:20 000

1 Mile

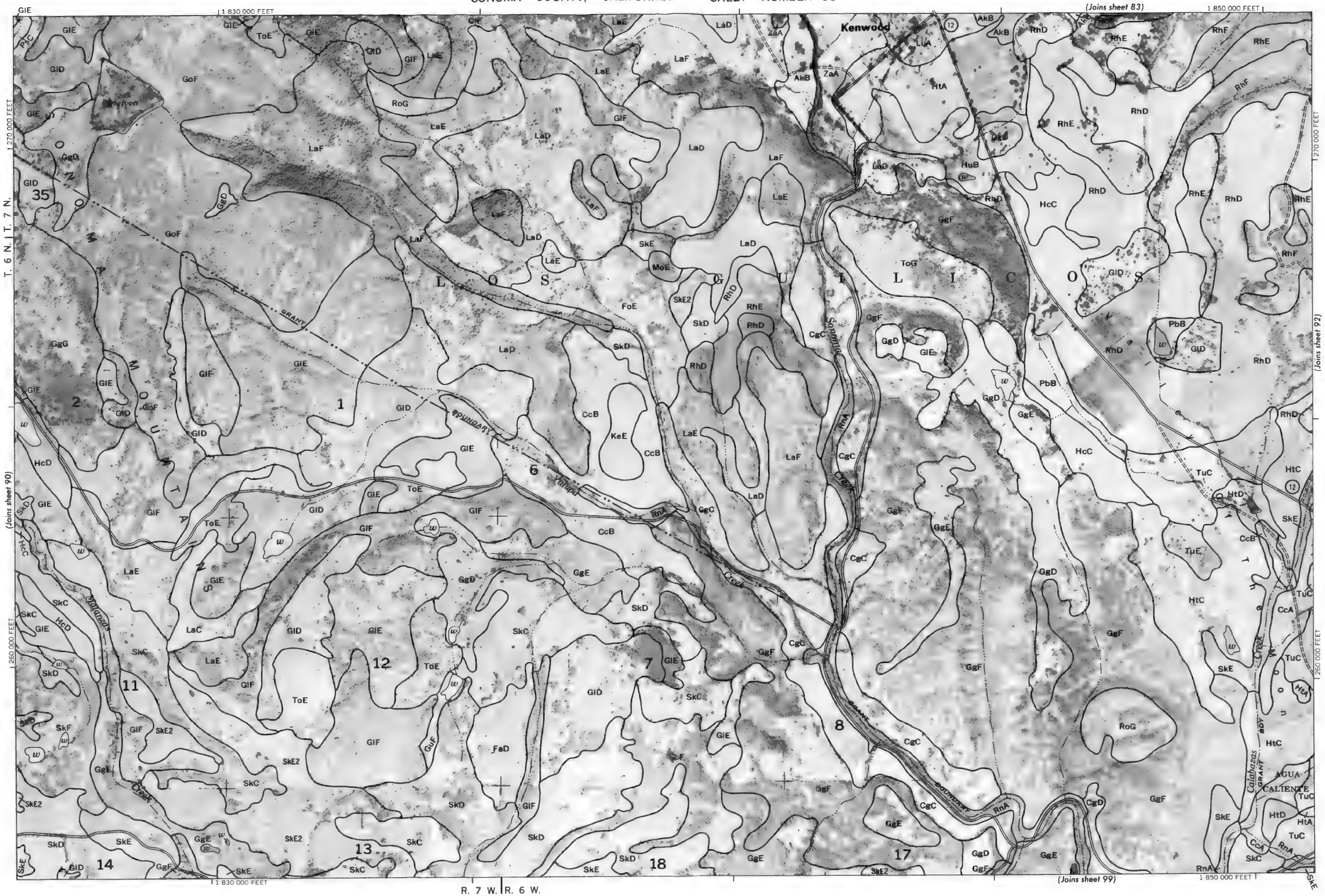
5000 Feet

Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 90



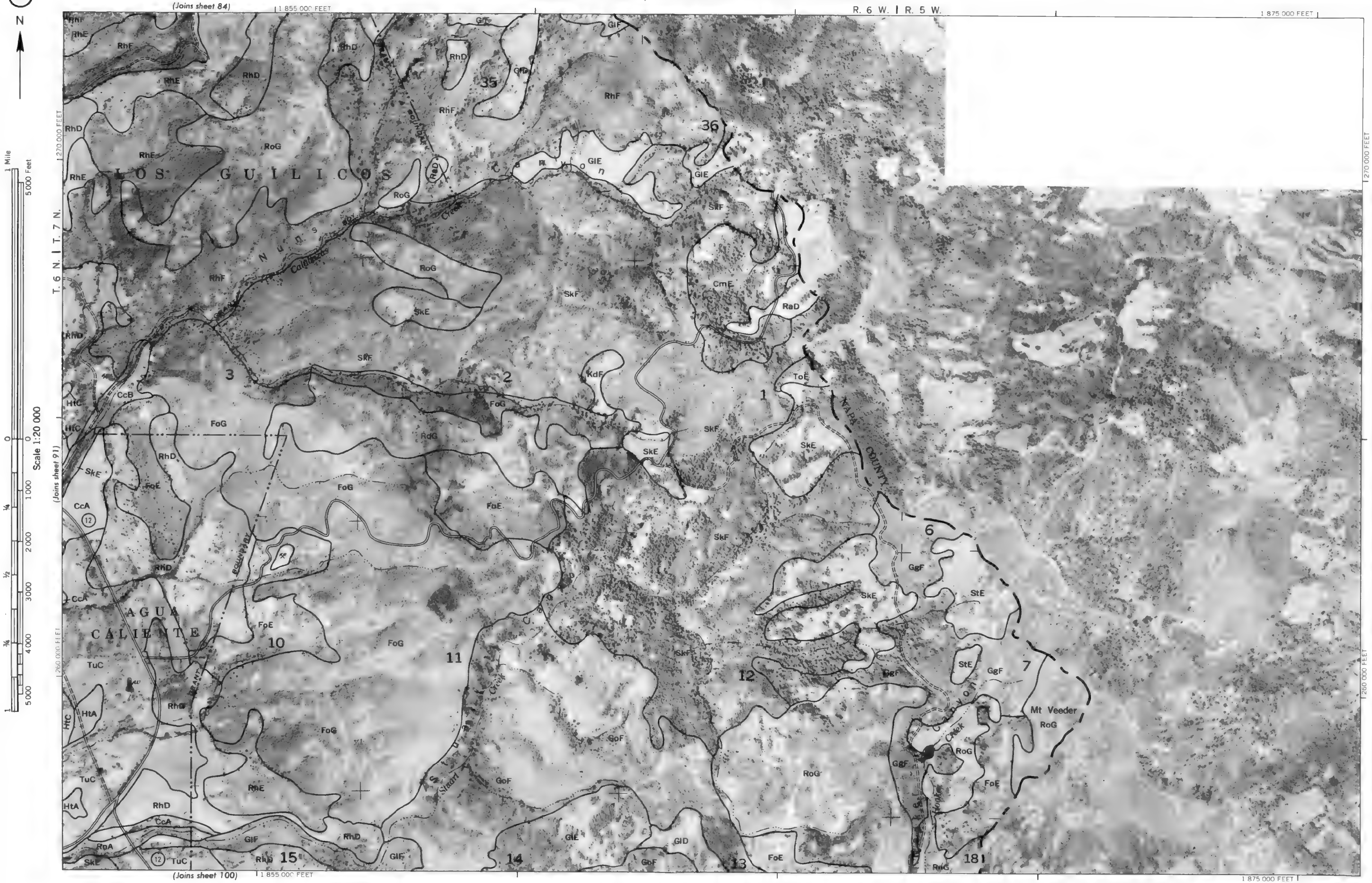
N

1 Mile
5000 Feet
Scale 1:20 000

SONOMA COUNTY, CALIFORNIA NO. 91

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.
Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 92



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

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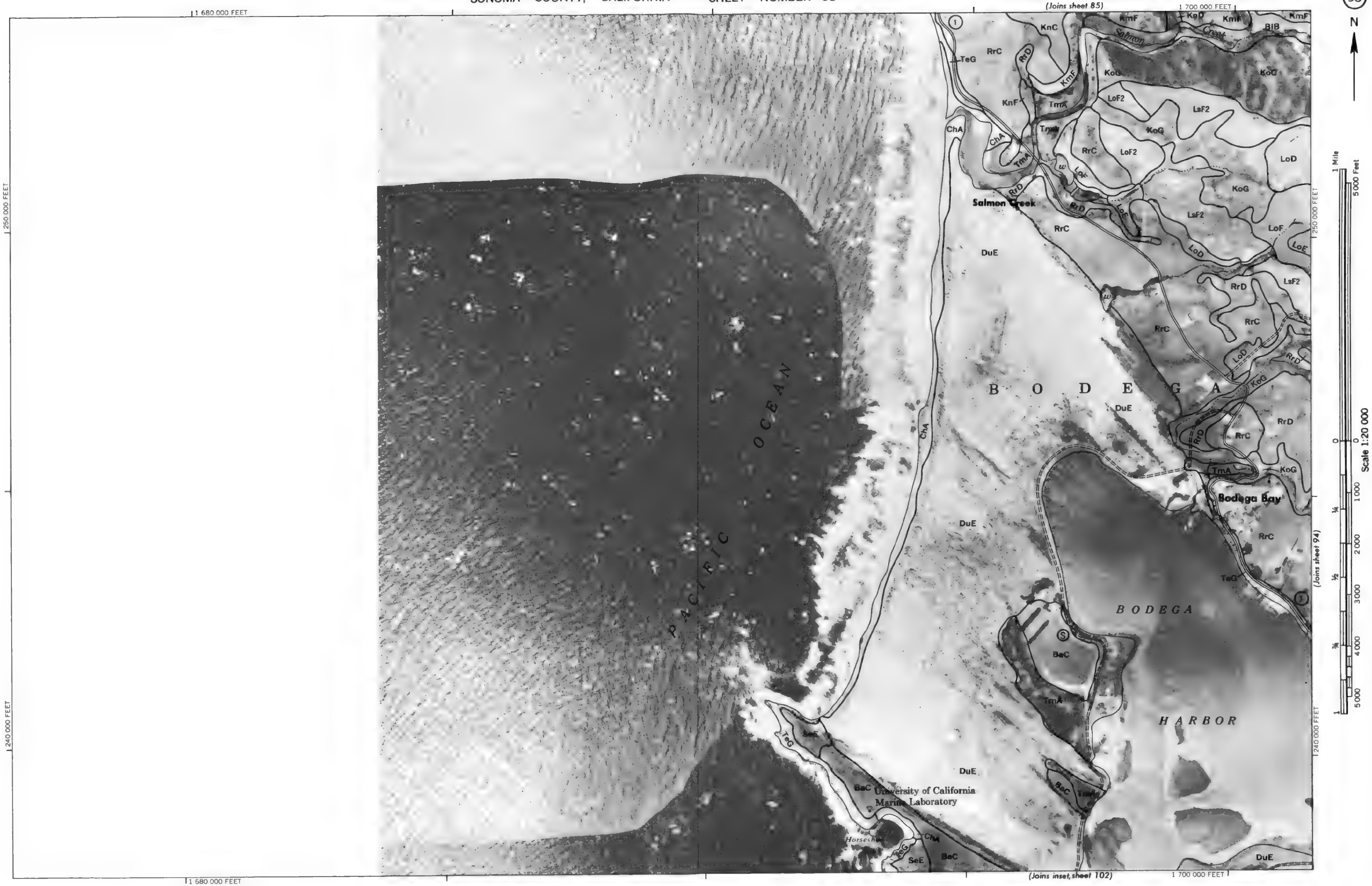
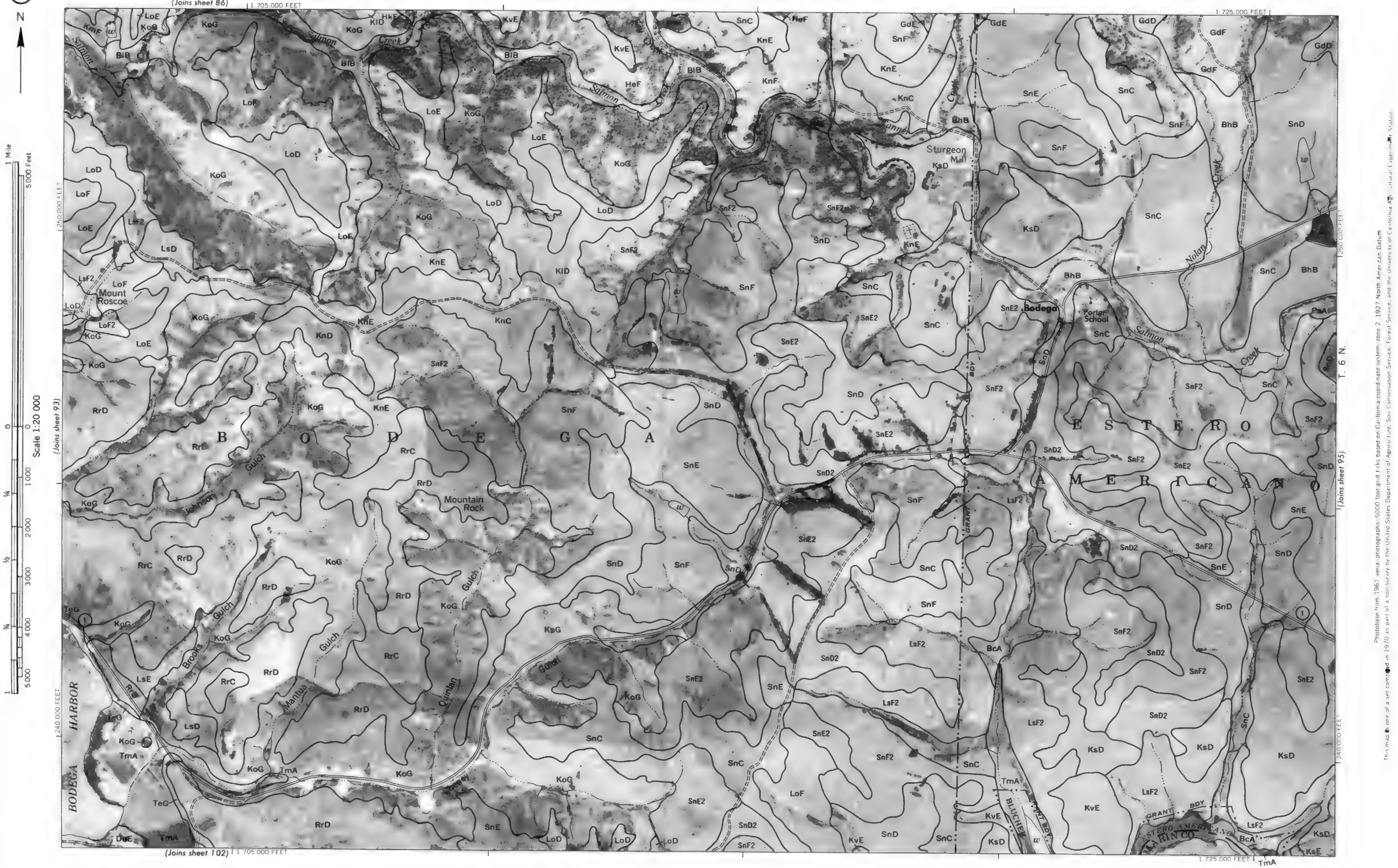


SONOMA COUNTY, CALIFORNIA NO. 93

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

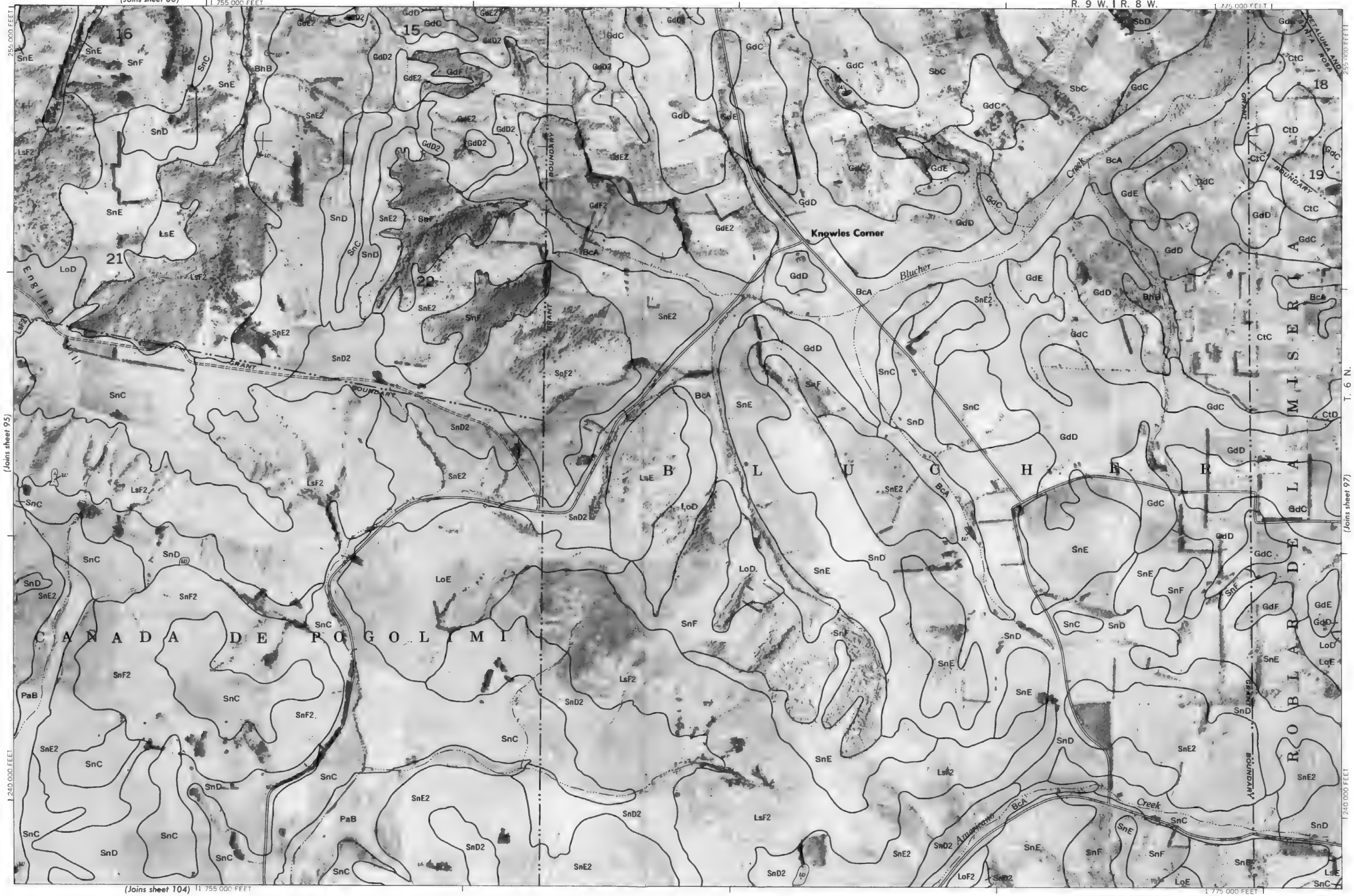
SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 94



SONOMA COUNTY, CALIFORNIA NO. 95

This map is one of a set compiled in 1978 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.
Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 96



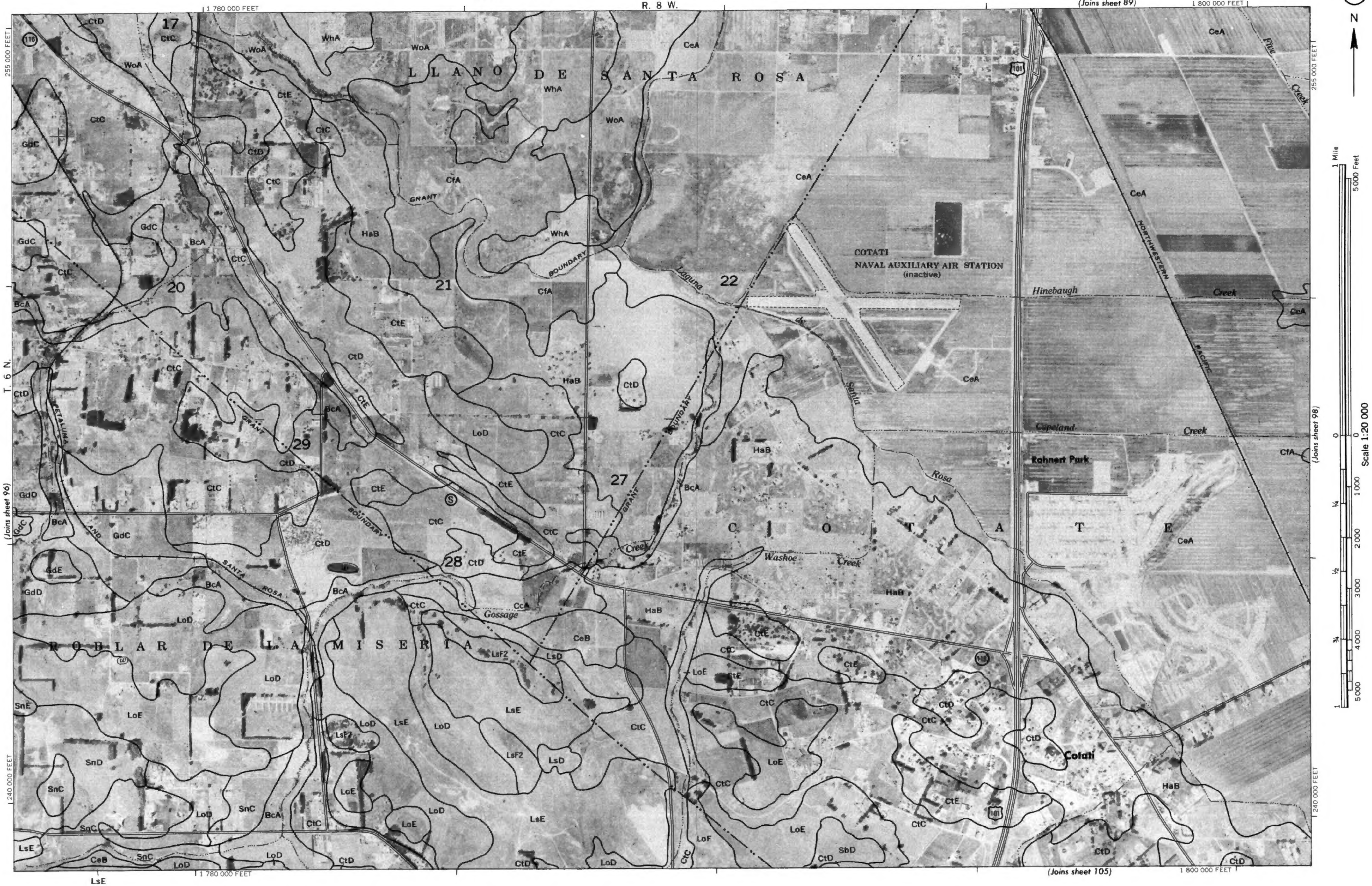
Land division corners are approximately positioned on this map

Photobase from 1961 aerial photographs. 5000 foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 97

97

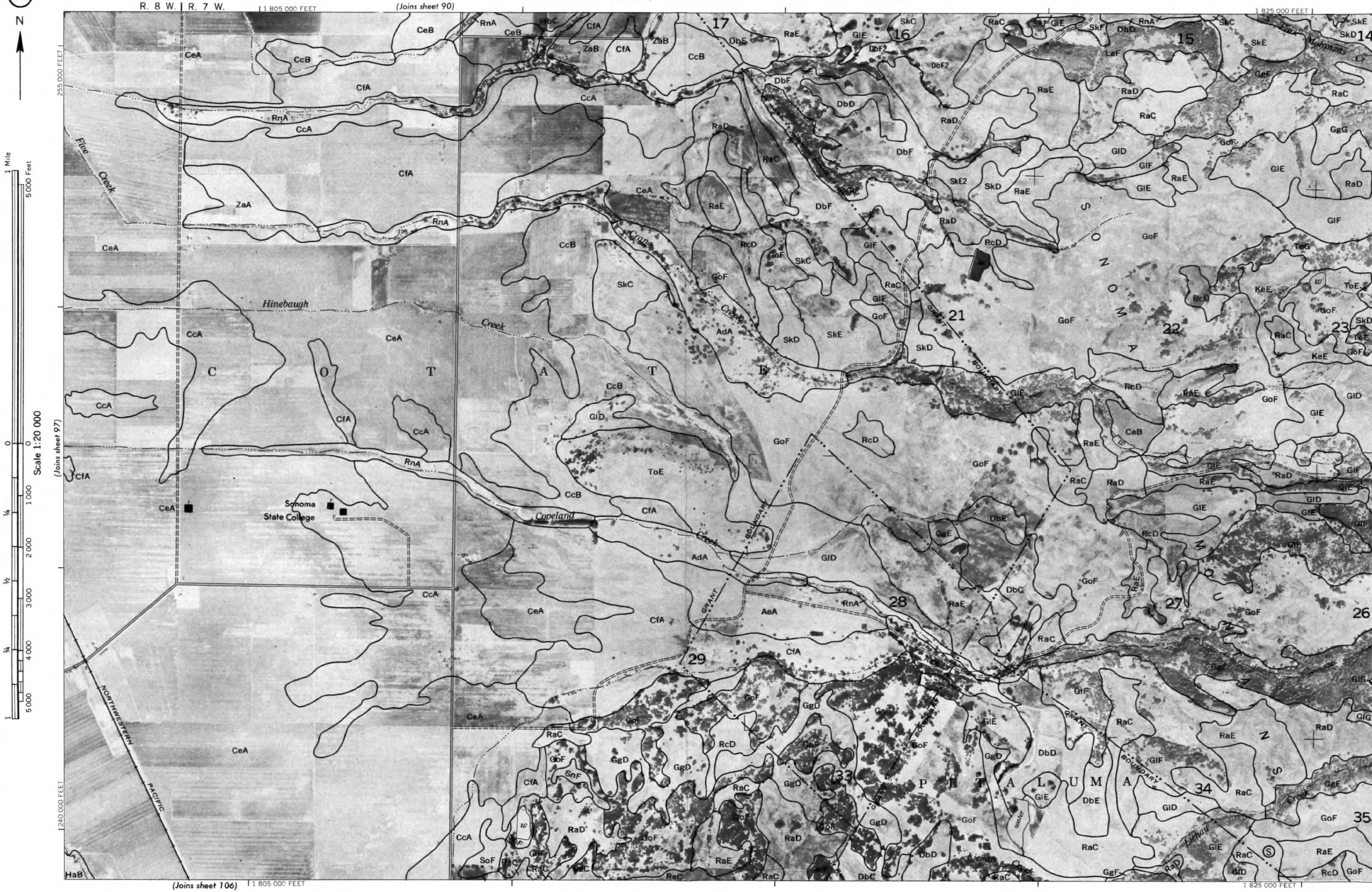


SONOMA COUNTY, CALIFORNIA NO. 97

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station. Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

Land division corners are approximately positioned on this map.

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 98



Land division corners are approximately positioned on this map.

Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2, 1927 North American Datum

This map is one of a set compiled in 1970 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, Forest Service, and the University of California Agricultural Experiment Station.

SONOMA COUNTY, CALIFORNIA NO. 98

SONOMA COUNTY, CALIFORNIA — SHEET NUMBER 99

SONOMA COUNTY, CALIFORNIA NO. 99

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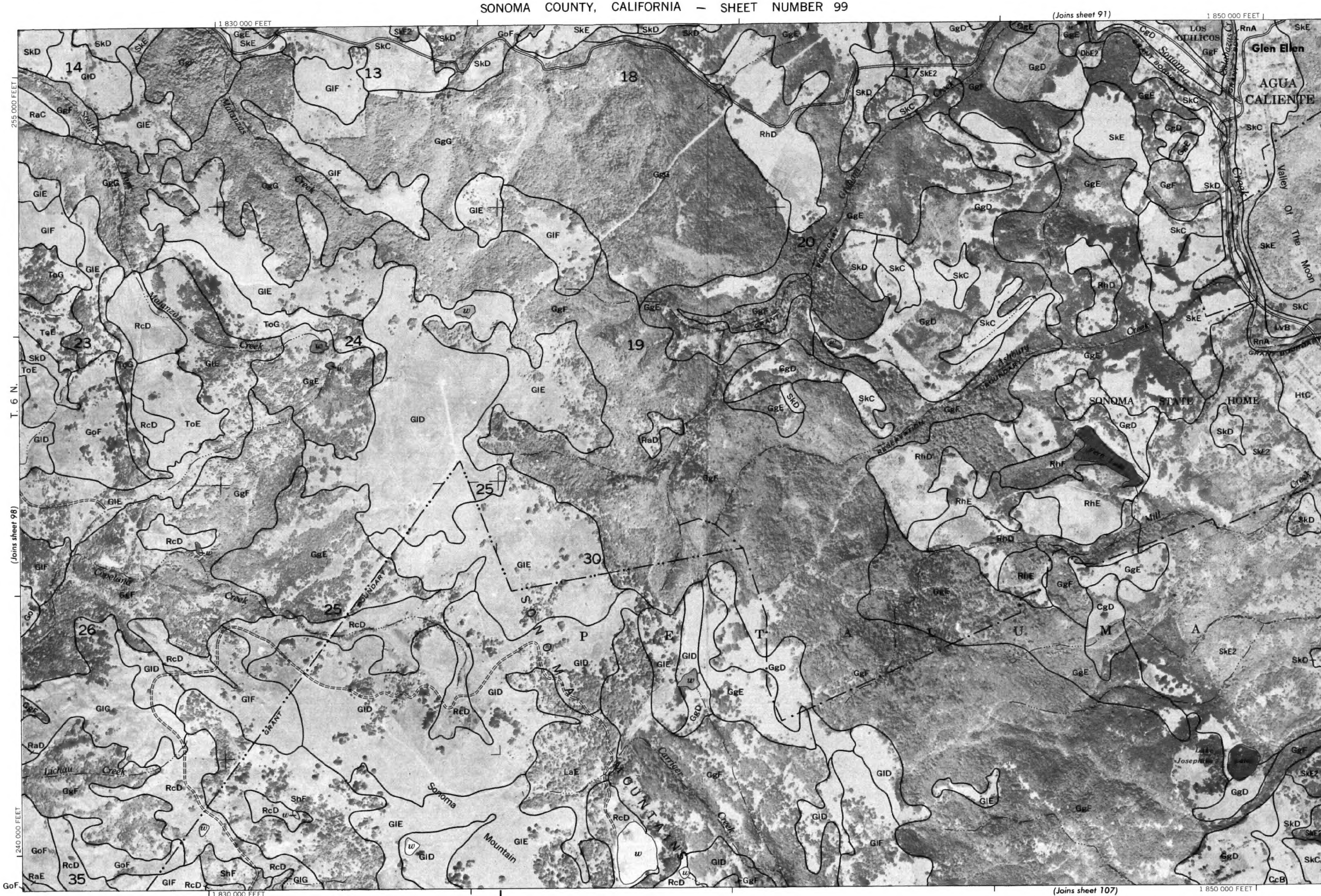
Photobase from 1961 aerial photographs. 5000-foot grid ticks based on California coordinate system, zone 2. 1927 North American Datum.

Land division corners are approximately positioned on this map.



N

1 Mile

5000 Feet

Scale 1:20 000

0 1000 2000 3000 4000 5000

0 ¼ ½ ¾ 1

LOCATION OF PROFILES REPRESENTATIVE OF SOIL SERIES

SOIL SERIES	MAP SHEET	PART OF SHEET
Arbuckle	65	NW
Atwell	78	NE
Baywood	93	SE
Blucher	87	NE
Boomer	31	SE
Caspar	43	SE
Cibo	64	NE
Clear Lake	111	NE
Clough	39	SE
Cohasset	33	SE
Cole	40	NW
Comptche	31	SW
Cortina	10	NE
Cotati	97	SW
Diablo	107	SW
Dibble	49	SE
Empire	34	NE
Felta	66	NW
Forward	31	NW
Goldridge	88	SW
Goulding	90	SW
Guenoc	21	SE
Haire	119	NE
Hely	78	SW
Henneke	76	SW
Hugo	45	SW
Huichica	65	SE
Huse	46	SE
Josephine	36	NW
Kidd	42	SW
Kinman	77	NE
Kneeland	85	SE
Kneeland sandy var.	95	SW
Laniger	112	NE
Laughlin	45	SW
Los Gatos	47	SW
Los Osos	116	SE
Los Robles	83	SW
Manzanita	30	SW
Maymen	46	SE
Mendocino	25	SW
Montara	79	SW
Noyo	60 (Inset)	SW
Pajaro	105	SW
Pleasanton	39	NE
Positas	40	SE
Raynor	98	SE
Red Hill	64	SE
Reyes	119	NW
Rohnerville	85	SE
Sebastopol	80	NW
Sheridan	102 (Inset)	SW
Sites	37	NW
Sobrante	31	NE
Spreckels	66	NW
Steinbeck	95	SW
Stonyford	31	NE
Supan	21	SE
Suther	41	NE
Toomes	31	NW
Tuscan	113	SW
Wright	88	NE
Yolo	65	NW
Yorkville	45	SW
Zamora	81	SW

SONOMA COUNTY, CALIFORNIA
CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Tunnel

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

BOUNDARIES

National or state

County

Reservation

Land grant

Small park, cemetery, airport

Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches (CANAL)

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Alluvial fan

Drainage end

RELIEF

Escarpments
- Bedrock
- Other

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

Soil boundary and symbol (Dx)

Gravel

Stoniness
- Stony
- Very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

Gully

Site of profile representative of soil series (S)